Orthogeriatrics—Clinical Summary Document

Treatment of osteoporosis in fragility fractures

Fragility fractures are extremely prevalent in older adults with a staggering cost of treatment. As the population ages, the number of fractures will increase, placing a significant burden on healthcare systems, society, and patients. For women, osteoporotic fractures pose a lifetime risk of death comparable to breast cancer, ovarian cancer, and uterine cancer combined. Fragility fractures are low-energy fractures that occur from a fall from standing height or less. The most common locations are vertebrae, hip, and wrist. A fragility fracture implies the diagnosis of osteoporosis. Unfortunately, most patients with this fracture are not given their diagnosis or offered treatment.

Diagnosis of osteoporosis

Bone density is typically measured using a dual-energy x-ray absorptiometry scan (DXA). DXA measures bone mass at the lumbar spine, each hip, and each forearm. Patients are compared against their peers with matching race and sex. The t score assesses the bone mineral density relative to the population at the time of peak bone mass (25 years of age). The z scores compare the patient to their age-matched peers. The World Health Organization defines a t score of ≤ -2.5 as osteoporosis, and scores of −1 to −2.5 as osteopenia. Any patient with a fragility fracture (regardless of t score) is defined as having osteoporosis.

Assessment of fragility fracture risk

Fragility fractures occur in bones with reduced bone quality and mineral density (ie, osteoporosis). The risk of developing such fractures is modulated by the presence of other risk factors including body mass index, previous fracture, parental history of hip fracture, use of oral glucocorticoids, age, alcohol intake, current smoking, and rheumatoid arthritis. If initiation of antiresorptive treatment is based on t score alone, some patients below the treatment threshold, but with additional factors increasing the overall fracture risk, will be left untreated. The Fracture Risk Assessment Tool (FRAX) was developed by The World Health Organization (WHO) to produce a more accurate 10-year probability of fracture by incorporating these other clinical risk factors. Fracture risk may be calculated with or without femoral neck bone mineral density measurements with the clinical risk factors. Assessment without bone mineral density measurements enables better identification of patients who warrant further investigation with a DXA scan. Fracture risk may then be more accurately calculated with this value, and individual countries may set intervention thresholds based on the ten-year fracture risk. The FRAX tool is available on the internet (www.shef.ac.uk/FRAX) and is validated for a number of countries worldwide. The FRAX tool relies on 13 questions and takes about 5 minutes to complete. It is not necessary to enter the patient's BMD result to get an accurate fracture risk assessment.

A Fragility fracture predicts future fractures

One of the greatest risk factors for future fragility fracture is a prior fragility fracture [1]. Prior fractures are important prognostic components of the FRAX score. In many studies, only about 20% of hip fracture and wrist fracture patients receive an assessment and treatment for osteoporosis [2].

Diagnostic workup for osteoporosis

Any adult patient with a fragility fracture should be assessed for osteoporosis. There are country-specific guidelines for the workup of patients with risk factors but no prior fracture. Approximately 30% of patients with osteoporosis have a secondary cause for the disease. This is particularly true in

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premenopausal women, men with osteoporosis (50–60%), and in patients who have suffered a hip fracture (≥ 80%). Appropriate laboratory testing is useful to assess for secondary causes. Serum calcium, 25-hydroxyvitamin D, intact parathyroid hormone, and thyroid stimulating hormone should be parts of the osteoporosis assessment. For patients with known renal compromise, measurement of 1,25-dihydroxyvitamin D should be added.

Vitamin D

Vitamin D insufficiency or deficiency is relatively common in all age ranges. Low-energy hip fracture patients have vitamin D insufficiency rates as high as 70–90%. Vitamin D is a hormone with many effects in the human body. It contributes to bone strength and mineralization, muscle strength, and balance in individuals over age 65 [3]. Vitamin D is fat soluble and produced from cholesterol in the skin. It can be obtained both from dietary sources (milk) and UV-B light striking the skin. It is hydroxylated at the 25th carbon in the liver, and then hydroxylated at the 1 carbon in the kidney to create the active form—1,25dihydroxyvitamin D. Vitamin D insufficiency is defined as a serum 25-vitamin D level < 32 ng/mL. Deficiency is defined as levels < 20 ng/mL. Because vitamin D is a fat soluble hormone, there is concern for accumulation and toxicity. Toxicity is accompanied by hypercalcemia (serum calcium levels ≥10.5 mg/dL). Toxicity is rare and is manifested by the symptoms of hypercalcemia: anorexia, nausea, polyuria, polydipsia, weakness, and pruritis.

Dosage: Current recommendations for patients are for 800–1200 iu vitamin D3 supplement in addition to dietary intake [4]. Older adults with obesity, darker skin pigmentation, anticonvulsant use, or malabsorption may require higher doses. Some experts suggest that 2000 iu of vitamin D3 daily is needed for maximal effect for adults, and this is being currently studied in the European DO-Health trial. Two forms of vitamin D are commercially available: vitamin D2 derived from plant sources and vitamin D3 derived from animal sources. Vitamin D2 is available in larger prescription doses (50,000 IU) but is inefficiently metabolized in humans. Vitamin D3 is the preferred form for supplementation [4].

Treatment for osteoporosis

A large number of medications are available for the treatment of osteoporosis. Most drugs inhibit the resorption of bone leading to osteoporosis. Teriparatide is the only treatment that is effective as an anabolic agent, stimulating the osteoblast to produce bone [5]. Bisphosphonates are analogs of hydroxyapatite that become incorporated into the crystalline structure of bone and inhibit the development and activity of osteoclasts. Bisphosphonates decelerate bone loss [6]. Zoledronic acid, a bisphosphonate given by intravenous infusion once yearly, was incidentally noted to decrease mortality after hip fractures [7].

Bisphosphonates are considered first-line therapy for most patients. When administered orally, bisphosphonates are often not well tolerated by patients. They should be taken with a full glass of water, and the patient should remain upright for one hour after the dose is swallowed. Compliance rates have been reported between 25–50% at six months for oral bisphosphonates. They are however very cost effective. Intravenous bisphosphonates can result in a flu-like illness for up to 24 hours after the dose is given.

Estrogen and estrogen/progesterone combinations are antiresorptive in nature but are not recommended due to the increased heart disease, stroke, and rate of invasive breast cancer [8].

Selective estrogen receptor modulators (SERM's) selectively stimulate the estrogen receptor to produce some of the bone sparing effects of estrogen [9]. SERM's do not only reduce fracture risk, but also reduce the risk of developing invasive breast cancer [9,10].

Denosumab is a monoclonal antibody to RANK ligand. Its mechanism of action involves inhibition of the development and activity of osteoclasts, thus decreasing bone resorption rates [11]. It has the advantage of subcutaneous dosing every six months and is an extremely potent antiresorptive agent. SERM's and denosumab are options for antiresorptive treatment if bisphosphonates are contraindicated or not tolerated.

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Strontium ranelate is an oral drug that is antiresorptive in nature. It is incorporated into the mineral structure of bone-inhibiting osteoclasts from resorbing bone and accelerating osteoclast apoptosis. It has been reported to result in increased bone mass, but this may be due to strontium's heavier molecular weight compared to calcium, which is detectable with DXA scanning. It is a second-line therapy when it is available.

Teriparatide is a recombinant-DNA analogue of parathyroid hormone and comprises of N-terminal 34 amino acids. It is dosed daily as a subcutaneous injection for 18–24 months. It is anabolic for bone formation and appears to stimulate both osteoblasts and osteoclasts, resulting in net increases in bone mass. It is designated for cases of failed antiresorptive therapy and cases of extremely severe osteoporosis in adults. Teriparatide is contraindicated in patients with open growth plates, malignancy, and Paget's disease of bone. Patients completing an 18–24 month course of teriparatide should be placed on an antiresorptive regimen to retain the gains in bone mass realized from the treatment. It is unclear if repeating courses of teriparatide will be beneficial to osteoporosis patients; therefore, further study is required.

Regardless of the treatment for osteoporosis, all patients require adequate calcium and vitamin D intake. Generally this requires supplements. Most individuals only obtain 600–700 mg of calcium through their diet and require either an increase in dietary intake or supplements to reach the daily intake goal. Current recommendations suggest that 500 mg of calcium should be added to vitamin D supplementation.

Vitamin D supplements should be given with the goal of maintaining a serum 25 vitamin D level of 32 ng/mL or higher. Counseling should be provided to all patients to encourage weight-bearing activities, smoking cessation, falls prevention, and activity modifications to minimize the risk of future fracture. Persistence with osteoporosis medications is a problem [12]. Regardless of treatment type, 1/3 to 1/2 of patients do not take their medications as prescribed within the first year, with persistence rates for bisphosphonates as low as 20% at 24 months [13]. Fracture protection is related to medication persistence, and patients should be reminded that they will not get the full benefit of their osteoporosis medication unless they take it as prescribed and continue to take the medication, even after their fragility fracture has healed.

Long term treatment

Osteoporosis is a chronic disease. A patient's needs may therefore require periodic reassessment. Reassessment should be considered for patients on long-term treatment for osteoporosis. DXA scanning every two years and measurement of both serum calcium and 25-hydroxy vitamin D levels are commonly performed studies. After five years of bisphosphonate therapy, assessment of bone turnover can be performed with urine N-telopeptide level measurement. N-telopeptide serves as a proxy for bone metabolic activity and can assist the clinician with decisions about continuing or changing therapy. Development of a new fracture while on therapy should also prompt reexamination of the treatment regimen and metabolic bone markers.

Surgeons save bones: an algorithm for orthopedic surgeons managing secondary fracture prevention

Based on the current literature, a new algorithm proposing a safe and simple guided pathway for appropriately treating osteoporosis in postmenopausal women after fragility fractures was published in 2013 [14].

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Recommended readings

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