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Osteoporosis

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Osteoporosis facts

- Osteoporosis is a condition of fragile bone with an increased susceptibility to fracture.
- Osteoporosis weakens bone and increases risk of bones breaking.
- Bone mass (bone density) decreases after 35 years of age, and bone loss occurs more rapidly in women after menopause.
- Key risk factors for osteoporosis include genetics, lack of exercise, lack of calcium and vitamin D, personal history of fracture as an adult, cigarette smoking, excessive alcohol consumption, history of rheumatoid arthritis, low body weight, and family history of osteoporosis.
- Patients with osteoporosis have no symptoms until bone fractures occur.
- The diagnosis of osteoporosis can be suggested by X-rays and confirmed by tests to measure bone density.
- Treatments for osteoporosis, in addition to prescription osteoporosis medications, include stopping use of alcohol and cigarettes, and assuring adequate exercise, calcium, and vitamin D.

What is osteoporosis?

Osteoporosis is a condition characterized by a decrease in the density of bone, decreasing its strength and resulting in fragile bones. Osteoporosis literally leads to abnormally porous bone that is compressible, like a sponge. This disorder of the skeleton weakens the bone and results in frequent fractures (breaks) in the bones. Osteopenia is a condition of bone that is slightly less dense than normal bone but not to the degree of bone in osteoporosis.

Normal bone is composed of protein, collagen, and calcium, all of which give bone its strength. Bones that are affected by osteoporosis can break (fracture) with relatively minor injury that normally would not cause a bone to fracture. The fracture can be either in the form of cracking (as in a hip fracture) or collapsing (as in a compression fracture of the vertebrae of the spine). The spine, hips, ribs, and wrists are common areas of bone fractures from osteoporosis although osteoporosis-related fractures can occur in almost any skeletal bone.

What are osteoporosis **symptoms** and signs?

Osteoporosis can be present without any symptoms for decades because osteoporosis doesn't cause symptoms until bone fractures. Moreover, some osteoporotic fractures may escape detection for years when they do not cause symptoms. Therefore, patients may not be aware of their osteoporosis until they suffer a painful fracture. The symptom associated with osteoporotic fractures usually is pain; the location of the pain depends on the location of the fracture. The symptoms of osteoporosis in men are similar to the symptoms of osteoporosis in women.

Fractures of the spine (vertebra) can cause severe "band-like" pain that radiates from the back to the sides of the body. Over the years, repeated spinal fractures can lead to chronic lower back pain as well as loss of height and/or curving of the spine due to collapse of the vertebrae. The collapse gives individuals a hunched-back appearance of the upper back, often called a "dowager hump" because it commonly is seen in elderly women.

A fracture that occurs during the course of normal activity is called a minimal trauma, or stress fracture. For example, some patients with osteoporosis develop stress fractures of the feet while walking or stepping off a curb.

Hip fractures typically occur as a result of a fall. With osteoporosis, hip fractures can occur as a result of trivial slip-and-fall accidents. Hip fractures also may heal slowly or poorly after surgical repair because of poor healing of the bone.

What are the consequences of osteoporosis?

Osteoporotic bone fractures are responsible for considerable pain, decreased quality of life, lost workdays, and disability. Up to 30% of patients suffering a hip fracture will require long-term nursing-home care. Elderly patients can develop pneumonia and blood clots in the leg veins that can travel to the lungs (pulmonary embolism) due to prolonged bed rest after the hip fracture. Osteoporosis has even been linked with an increased risk of death. Some 20% of women with a hip fracture will die in the subsequent year as an indirect result of the fracture. In addition, once a person has experienced a spine fracture due to osteoporosis, he or she is at very high risk of suffering another such fracture in the near future (next few years). About 20% of postmenopausal women who experience a vertebral fracture will suffer a new vertebral fracture of bone in the following year.

Why is osteoporosis an important public-health issue?

- In the U.S., 44 million people have low bone density (10 million have osteoporosis, and 34 million have osteopenia). This amounts to 55% of the U.S. population aged 50 years and older.
- One in two Caucasian women will fracture a bone due to osteoporosis in her lifetime.
- In the U.S., direct health-care costs from osteoporosis fractures amount to a billion dollars, without even taking into account the indirect costs, such as lost days at work and productivity.
- Approximately 20% of those who experience a hip fracture will die in the year following the fracture.
- One-third of hip-fracture patients are discharged to a nursing home within the year after fracture.
- Only one-third of hip-fracture patients regain their pre-fracture level of function.

With the aging of America, the number of people with osteoporosis-related fractures will increase exponentially. The pain, suffering, and overall impact on health and economic costs will be enormous.

What factors determine bone strength?

Bone mass (bone density) is determined by the amount of bone present in the skeletal structure. Generally, the higher the bone density, the stronger the bones. Bone density is greatly influenced by genetic factors, which in turn are sometimes modified by environmental factors and medications. For example, men have a higher bone density than women, and African Americans have a higher bone density than Caucasian or Asian Americans.

Normally, bone density accumulates during childhood and reaches a peak by around age 25. Bone density then is maintained for about 10 years. After age 35, both men and women will normally lose 0.3%-0.5% of their bone density per year as part of the aging process.

Estrogen is important in maintaining bone density in women. When estrogen levels drop after menopause, loss of bone density accelerates. During the first five to 10 years after menopause, women can suffer up to 2%-4% loss of bone density per year! This can result in the loss of up to 25%-30% of their bone density during that time period. The accelerated bone loss after menopause is a major cause of osteoporosis in women, referred to as postmenopausal osteoporosis.

What are osteoporosis risk factors and causes?

The following are factors that will increase the risk of developing osteoporosis:

- Female gender
- Caucasian or Asian race
- Thin and small body frame
- Family history of osteoporosis (for example, having a mother with an osteoporotic hip fracture doubles your risk of hip fracture)
- Personal history of fracture as an adult
- Cigarette smoking
- Excessive alcohol consumption
- Lack of exercise
- Diet low in calcium

- Poor nutrition and poor general health
- Malabsorption (nutrients are not properly absorbed from the gastrointestinal system) from conditions such as celiac sprue
- Low estrogen levels in women (such as occur in menopause or with early surgical removal of both ovaries)
- Low testosterone levels in men (hypogonadism)
- Chemotherapy that can cause early menopause due to its toxic effects on the ovaries
- Amenorrhea (loss of the menstrual period) in young women is associated with low estrogen and osteoporosis; amenorrhea can occur in women who undergo extremely vigorous exercise training and in women with very low body fat (for example, women with anorexia nervosa)
- Chronic inflammation, due to chronic diseases such as rheumatoid arthritis or liver diseases
- Immobility, such as after a stroke, or from any condition that interferes with walking
- Hyperthyroidism, a condition wherein too much thyroid hormone is produced by the thyroid gland (as in Grave's disease) or is ingested as thyroid hormone medication
- Hyperparathyroidism is a disease wherein there is excessive parathyroid hormone production by the parathyroid gland, a small gland located near or within the thyroid gland. Normally, parathyroid hormone maintains blood calcium levels by, in part, removing calcium from the bone. In untreated hyperparathyroidism, excessive parathyroid hormone causes too much calcium to be removed from the bone, which can lead to osteoporosis.
- When vitamin D is lacking, the body cannot absorb adequate amounts of calcium from the diet to prevent osteoporosis. Vitamin D deficiency can result from lack of intestinal absorption of the vitamin such as occurs in celiac sprue and primary biliary cirrhosis.
- Certain medications can cause osteoporosis. These include long-term use of heparin (a blood thinner), antiseizure medications such as phenytoin (Dilantin) and phenobarbital, and long-term use of oral corticosteroids (such as prednisone).
- Inherited disorders of connective tissue, including osteogenesis imperfecta, Marfan syndrome, Ehlers-Danlos syndrome, homocystinuria, and osteoporosis-pseudoglioma syndrome.

How is osteoporosis diagnosed?

A routine X-ray can reveal osteoporosis of the bone because the bones appear much thinner and lighter than normal bones. Unfortunately, by the time X-rays can detect osteoporosis, at least 30% of the bone has already been lost. In addition, X-rays are not accurate indicators of bone density. Thus, the appearance of the bone on X-ray often is affected by variations in the degree of exposure of the X-ray film.

The National Osteoporosis Foundation, the American Medical Association, and other major medical organizations recommend a dual-energy X-ray absorptiometry scan (DXA, formerly known as DEXA) be used for the diagnosis of osteoporosis. DXA typically measures bone density in the hip, the spine, and the forearm. The test takes only five to 15 minutes to perform, exposes patients to very little radiation (less than one-tenth to one-hundredth of the amount used on a standard chest X-ray), and is quite precise.

The bone density of the patient is compared to the average peak bone density of young adults of the same sex and race. This score is called the "T score," and it expresses the bone density in terms of the number of standard deviations (SD) below peak young adult bone mass.

- Osteoporosis is defined as a bone density T score of -2.5 or below.
- Osteopenia (between normal and osteoporosis) is defined as bone density T score between -1 and -2.5.

It is important to note that while osteopenia is considered a lesser degree of bone loss than osteoporosis, it nevertheless can be of concern when it is associated with other risk factors (such as smoking, cortisone steroid usage, rheumatoid arthritis, family history of osteoporosis, etc.) that can increase the chances for developing vertebral, hip, and other fractures. In this setting, osteopenia may require medication as part of the treatment program.

Who should have bone density testing?

The National Osteoporosis Foundation guidelines state that there are several groups of people who should consider DXA testing:

- All postmenopausal women below age 65 who have risk factors for osteoporosis

- All women aged 65 and older
- Postmenopausal women with fractures, although this is not mandatory because treatment may well be started regardless of bone density
- Women with any of more than 50 medical conditions associated with osteoporosis; a primary-care physician can scan a patient's list of medical illnesses to determine if one of these conditions is present (see causes above)
- Women whose decision to begin treatment for osteoporosis might be aided by bone density testing to determine the presence or absence of osteoporosis or osteopenia

The National Osteoporosis Foundation guidelines state that bone-density testing does not need to be performed if a person has a known osteoporotic fracture because the patient will be treated for osteoporosis with or without a bone-density study. In addition, bone-density testing is not appropriate if the person undergoing the test is not willing to take treatment based on the results. Therefore, if bone-density testing is done, it should be performed on people willing to take some specific action based on the results.

What is the **treatment** for osteoporosis, and can osteoporosis be prevented?

The goal of treatment of osteoporosis is the prevention of bone fractures by reducing bone loss or, preferably, by increasing bone density and strength. Although early detection and timely treatment of osteoporosis can substantially decrease the risk of future fractures, none of the available treatments for osteoporosis are complete cures. In other words, it is difficult to completely rebuild bone that has been weakened by osteoporosis. Therefore, prevention of osteoporosis is as important as treatment. The following are osteoporosis treatment and prevention measures:

1. **Lifestyle changes**, including quitting cigarette smoking, curtailing excessive alcohol intake, exercising regularly, and consuming a balanced diet with adequate calcium and vitamin D
2. **Medications that stop bone loss and increase bone strength**, such as alendronate (Fosamax), risedronate (Actonel), raloxifene (Evista), ibandronate (Boniva), calcitonin (Calcimar), zoledronate (Reclast), and denosumab (Prolia)
3. **Medications that increase bone formation** such as teriparatide (Forteo)

Exercise, quitting cigarettes, and curtailing alcohol

Exercise has a wide variety of beneficial health effects. However, exercise does not bring about substantial increases in bone density. The benefit of exercise for osteoporosis has mostly to do with decreasing the risk of falls, probably because balance is improved and/or muscle strength is increased. Research has not yet determined what type of exercise is best for osteoporosis or for how long it should be continued. Until research has answered these questions, most doctors recommend weight-bearing exercise, such as walking, preferably daily.

A word of caution about exercise: It is important to avoid exercises that can injure already weakened bones. In patients over 40 and those with heart disease, obesity, diabetes mellitus, and high blood pressure, exercise should be prescribed and monitored by physicians. Extreme levels of exercise (such as marathon running) may not be healthy for the bones. Marathon running in young women that leads to weight loss and loss of menstrual periods can actually promote osteoporosis.

Smoking one pack of cigarettes per day throughout adult life can itself lead to loss of 5%-10% of bone mass. Smoking cigarettes decreases estrogen levels and can lead to bone loss in women before menopause. Smoking cigarettes also can lead to earlier menopause. In postmenopausal women, smoking is linked with increased risk of osteoporosis. Data on the effect of regular consumption of alcohol and caffeine on osteoporosis is not as clear as with exercise and cigarettes. In fact, research regarding alcohol and caffeine as risk factors for osteoporosis shows widely varying results and is controversial. Certainly, their effects are not as great as other factors. Nevertheless, moderation of both alcohol and caffeine is prudent.

Calcium supplements

Building strong and healthy bones requires an adequate dietary intake of calcium beginning in childhood and adolescence for both sexes. Most importantly, however, a high dietary calcium intake or taking calcium supplements alone is not sufficient in treating osteoporosis and should not be viewed as an alternative to or substituted for more potent prescription medications for osteoporosis. In the first several years after menopause, rapid bone loss may occur even if calcium supplements are taken.

The following calcium intake has been recommended by the National Institutes of Health Consensus Conference on Osteoporosis for all people, with or without osteoporosis:

- 800 mg/day for children 1-10 years of age
- 1,000 mg/day for men, premenopausal women, and postmenopausal women also taking estrogen
- 1,200 mg/day for teenagers and young adults 11-24 years of age
- 1,500 mg/day for postmenopausal women not taking estrogen
- 1,200 mg-1,500 mg/day for pregnant and nursing mothers
- The total daily intake of calcium should not exceed 2,000 mg.

Daily calcium intake can be calculated by the following method:

1. Excluding dairy products, the average American diet contains approximately 250 mg of calcium.
2. There is approximately 300 mg of calcium in an 8-ounce glass of milk.
3. There is approximately 450 mg of calcium in 8 ounces of plain yogurt.
4. There is approximately 130 mg of calcium in 1 cup of cottage cheese.
5. There is approximately 200 mg of calcium in 1 ounce of cheddar cheese.
6. There is approximately 90 mg of calcium in ½ cup of vanilla ice cream.
7. There is approximately 300 mg of calcium in 8 ounces of calcium-fortified orange juice.

Unfortunately, surveys have shown that the average woman in the U.S. is consuming less than 500 mg of calcium per day in their diet, less than the recommended amounts. Additional calcium can be obtained by drinking more milk and eating more yogurt or cottage cheese or by taking calcium supplement tablets as well from calcium-fortified foods, such as orange juice.

The various calcium supplements contain different amounts of elemental calcium (the actual amount of calcium in the supplement). For example, Caltrate, Os-Cal, and Tums are calcium carbonate salts. Each 1,250 mg of calcium carbonate salt tablet (such as Caltrate 600 mg, Os-Cal 500 mg, or Tums 500 mg extra strength) contains 500 mg of elemental calcium. A person who needs 1,000 mg/day of calcium supplement can take one tablet of Tums 500 mg extra strength (containing 500 mg of elemental calcium) twice daily with meals.

The calcium carbonate supplements are best taken in small divided doses with meals since the intestines may not be able to reliably absorb more than 500 mg of calcium all at once. Therefore, the best way to take 1,000 mg of a calcium supplement is to divide it into two doses. Likewise, a dosage of 1,500 mg should be split into three doses.

Calcium supplements are safe and generally well tolerated. Side effects are indigestion and constipation. If constipation and indigestion occur with calcium carbonate supplements, calcium citrate (Citracal) can be used. Some patients have difficulty swallowing calcium tablets. In this situation, chewable candy-like calcium in the form of Viactiv is available. Certain medications can interfere with the absorption of calcium carbonate. Examples of such medications include proton-pump inhibitors such as omeprazole (Prilosec), lansoprazole (Prevacid), lansoprazole (Protonix), and rabeprazole (Aciphex), which are used in treating gastroesophageal reflux disease (GERD) or peptic ulcers. When these medications are being taken, calcium citrate is preferred.

Many "natural" calcium carbonate preparations, such as oyster shells or bone meal, may contain high levels of lead or other harmful elements and should be avoided.

Vitamin D

An adequate intake of calcium and vitamin D are important foundations for maintaining bone density and strength. However, calcium and vitamin D alone are not sufficient to treat osteoporosis and should be given in conjunction with other treatments. Vitamin D is important in several respects:

- Vitamin D helps the absorption of dietary calcium from the intestines.
- The lack of vitamin D alone can cause calcium-depleted bone (osteomalacia), which further weakens the bones and increases the risk of fractures.
- Vitamin D, along with adequate calcium (1,200 mg of elemental calcium), has been shown in some studies to increase bone density and decrease fractures in postmenopausal women but not in premenopausal or perimenopausal women.

Vitamin D comes from the diet and the skin. Vitamin D production by the skin is dependent on exposure to

sunlight. Active people living in sunny regions (Southern California, Hawaii, countries around the equator, etc.) can produce most of the vitamin D they need in their skin. Conversely, lack of exposure to sunlight, due to residence in northern latitudes or physical incapacitation, causes vitamin D deficiency. In less temperate regions such as Minnesota, Michigan, and New York, production of vitamin D by the skin is markedly diminished in the winter months, especially among the elderly. In that population, dietary vitamin D becomes more important.

Unfortunately, vitamin D deficiency is quite common in the U.S. In a study in a general medical ward of one hospital, vitamin D deficiency was detected in 57% of the patients. An estimated 50% of elderly women consume far less vitamin D in their diet than is recommended.

The Food and Nutrition Board of the Institute of Medicine has recommended the following as an adequate vitamin D intake:

- 800 IU/day for men and women over the age of 71
- 600 IU/day for women in other age groups, men, and children
- 400 IU/day for infants under 12 months

But if a person already has osteoporosis, it is advisable to ensure 400 IU twice per day as the usual daily intake, most commonly as a supplement alongside prescribed medications for osteoporosis.

An average multivitamin tablet contains 400 IU of vitamin D. Therefore, one to two multivitamins a day should provide the recommended amount of vitamin D. Alternatively, vitamin D can be obtained in combination with calcium in tablet forms, such as Caltrate 600 + D (600 mg of calcium and 200 IU of vitamin D) and others.

Adequate levels of calcium and vitamin D are essential for optimal bone health, especially when used with prescribed medication for osteoporosis. Chronic excessive use of vitamin D can lead to toxic levels of vitamin D, elevated calcium levels in blood and urine, and may also cause kidney stones. Since various dietary supplements may also contain vitamin D, it is important to review vitamin D content in dietary supplements before taking additional vitamin D.

Hormone therapy (menopausal hormone therapy)

Estrogen hormone therapy after menopause (previously referred to as hormone replacement therapy or HRT) has been shown to prevent bone loss, increase bone density, and prevent bone fractures. It is useful in preventing osteoporosis in postmenopausal women. Estrogen is available orally (Premarin, Estrace, Estratest, and others) or as a skin patch (Estraderm, Vivelle, and others).

Estrogen also is available in combination with progesterone as pills and patches. Progesterone is routinely given along with estrogen to prevent uterine cancer that might result from estrogen use alone. Women who have had a hysterectomy (surgical removal of the uterus) may take estrogen alone since they no longer have a uterus to become cancerous. Nasally delivered estrogen and lower-dose combination pills of estrogen and progesterone are also being studied. However, due to adverse effects of HRT, such as increased risks of heart attack, stroke, blood clots in the veins, and breast cancer; HRT is no longer recommended for long-term use in the therapy of osteoporosis. Rather, HRT is used short term to relieve menopausal hot flashes.

Every woman needs to have an individualized discussion regarding HRT with her doctor because each woman will place different weight on the risks and benefits of the treatment.

Medications that prevent bone loss and breakdown

Currently, the most effective medications for osteoporosis that are approved by the FDA are antiresorptive agents, which decrease the removal of calcium from bones. The bone is a living dynamic structure; it is constantly being built and removed (resorbed). This process is an essential part of maintaining the normal calcium level in the blood and serves to repair tiny cracks in the bones that occur with normal daily activity and to remodel bone based on the physical stresses placed on the bone. Osteoporosis results when the rate of bone resorption exceeds the rate of bone rebuilding. Antiresorptive medications inhibit removal of bone (resorption), thus tipping the balance in favor of bone rebuilding and increasing bone density. HRT is one example of an antiresorptive agent. Others include alendronate (Fosamax), risedronate (Actonel), raloxifene (Evista), ibandronate (Boniva), calcitonin (Calcimar), zoledronate (Reclast), and denosumab (Prolia).

Bisphosphonates

Bisphosphonates decrease the risk of hip fracture, wrist fracture, and spine fracture in people with

osteoporosis. Alendronate (Fosamax), risedronate (Actonel, Atelvia), ibandronate (Boniva), and zoledronate (Reclast) are bisphosphonates.

To reduce side effects and to enhance absorption of the medicine, all bisphosphonates taken by mouth (orally) should be taken in the morning, on an empty stomach, 30 minutes before breakfast, and with at least 8 ounces (240 ml) of water (not juice). This improves the absorption of the bisphosphonate. Taking the pill sitting or standing (as well as drinking adequate amounts of liquids) minimizes the chances of the pill being lodged in the esophagus, where it can cause ulceration and scarring. Patients should also remain upright for at least 30 minutes after taking the pill to avoid reflux of the pill into the esophagus. Newer intravenous bisphosphonates, such as ibandronate (Boniva) and zoledronate (Reclast), bypass the potential esophagus and stomach problems.

Food, calcium, iron supplements, vitamins with minerals, or antacids containing calcium, magnesium, or aluminum can reduce the absorption of oral bisphosphonates, thereby resulting in loss of effectiveness. Therefore, oral bisphosphonates should be taken with plain water only in the morning before breakfast. Also, no food or drink should be taken for at least 30 minutes afterward.

Alendronate (Fosamax)

Alendronate (Fosamax) is a bisphosphonate antiresorptive medication. Alendronate is approved for the prevention and treatment of postmenopausal osteoporosis as well as for osteoporosis that is caused by cortisone-related medications (glucocorticoid-induced osteoporosis). Alendronate has been shown to increase bone density and reduce fractures in the spine, hips, and arms. Fosamax is taken by mouth once a week to prevent and treat postmenopausal osteoporosis. Alendronate is the first osteoporosis medication also approved for increasing bone density in men with osteoporosis, either in a daily or a weekly dosing schedule.

Fosamax generally is well tolerated with few side effects. One side effect of alendronate is irritation of the esophagus (the food pipe connecting the mouth to the stomach). Inflammation of the esophagus (esophagitis) and ulcers of the esophagus have been reported infrequently with alendronate use.

Risedronate (Actonel)

Risedronate (Actonel, Atelvia) is another bisphosphonate antiresorptive medication. Like alendronate, this drug is approved for the prevention and treatment of postmenopausal osteoporosis as well as for osteoporosis that is caused by cortisone-related medications (glucocorticoid-induced osteoporosis). Risedronate is chemically different from alendronate and has less likelihood of causing esophageal irritation. Risedronate also is more potent in preventing the resorption of bone than alendronate.

Ibandronate (Boniva)

Ibandronate (Boniva) is a bisphosphonate for prevention and treatment of postmenopausal osteoporosis. It is available in formulations for both daily and monthly oral use as well as for intravenous use every three months.

Zoledronate (Reclast)

Zoledronate (Reclast) is a unique intravenous bisphosphonate antiresorptive medication that is given once every year. This formulation seems to have very good ability to strengthen bones and prevent fractures of both spinal and nonspinal bones. The convenience of once-a-year dosing is obvious. As with all bisphosphonates, patients taking Reclast must be taking adequate calcium and vitamin D prior to and after infusion of the medication for optimal results. Generally, patients are given acetaminophen (Tylenol) the day of the infusion and for several days afterward to prevent occasional minor muscle and joint aches. The infusion lasts approximately 20-30 minutes. Reclast is used to treat and prevent osteoporosis in postmenopausal women and increases bone mass in men with osteoporosis. Reclast is also used to treat and prevent steroid-induced osteoporosis (glucocorticoid-induced osteoporosis). Reclast reduces risk of fractures after a low-trauma hip fracture. Reclast should not be used during or prior to pregnancy.

Selective estrogen receptor modulators (SERMs)

Raloxifene (Evista)

Raloxifene (Evista) belongs to a class of drugs called selective estrogen receptor modulators (SERMs). SERMs work like estrogen in some tissues but as an antiestrogen in other tissues. The SERMs were developed to reap the benefits of estrogen while avoiding the potential side effects of estrogen. Thus, raloxifene can act like estrogen on bone but as an antiestrogen on the lining of the uterus where the effects of estrogen can promote cancer.

The first SERM to reach the market was tamoxifen (Nolvadex), which blocks the stimulative effect of estrogen on breast tissue. Tamoxifen has proven valuable in women who have had cancer in one breast for preventing cancer in the second breast. Raloxifene is the second SERM to be approved by the FDA. Evista has been approved for the prevention and treatment of osteoporosis in postmenopausal women. In a three-year study involving some 600 postmenopausal women, raloxifene was found to increase bone density (and lower LDL cholesterol) while having no detrimental effect on the uterine lining (which means that it is unlikely to cause uterine cancer).

Because of its antiestrogen effects, the most common side effects with Evista are hot flashes. Conversely, because of its estrogenic effects, Evista increases the risk of blood clots, including deep vein thrombosis (DVT) and pulmonary embolism (blood clots in the lung). The greatest increase in risk occurs during the first four months of use. Patients taking raloxifene should avoid prolonged periods of immobility during travel, when blood clots are more prone to occur. The risk of deep vein thrombosis with raloxifene is probably comparable to that of estrogen, about two to three times higher than the usual low rate of occurrence. Evista decreases the risk of spinal fractures in postmenopausal women with osteoporosis, but it is not known if there is a similar benefit in decreasing the risk of hip fracture. (The only agents that are definitely proven to decrease the risk of hip fracture are bisphosphonates and denosumab.)

Calcitonin (Calcimar, Miacalcin)

Calcitonin (Calcimar, Miacalcin) is a hormone that has been approved by the FDA in the U.S. for treating osteoporosis. Calcitonins come from several animal species, but salmon calcitonin is the one most widely used. Calcitonin can be administered as a shot under the skin (subcutaneously), into the muscle (intramuscularly), or inhaled nasally (intranasally). Intranasal calcitonin is the most convenient of the three methods of administration.

Calcitonin has been shown to prevent bone loss in postmenopausal women. In women with established osteoporosis, calcitonin has been shown to increase bone density and strength in the spine only.

Calcitonin is a weaker antiresorptive medication than bisphosphonates. Calcitonin is not as effective in increasing bone density and strengthening bone as estrogen and the other antiresorptive agents, particularly bisphosphonates. In addition, it is not as effective as bisphosphonates in reducing the risk of spinal fractures and has not been proven effective in reducing hip fracture risk. Therefore, calcitonin is not the first choice of treatment in women with established osteoporosis. Nevertheless, calcitonin is a helpful alternative treatment for patients who cannot tolerate other medications.

Common side effects of either injected or nasal spray calcitonin are nausea and flushing. Patients using Miacalcin Nasal Spray can develop nasal irritation, a runny nose, or nosebleeds. Injectable calcitonin can cause local skin redness at the site of injection, skin rash, and flushing.

Teriparatide (Forteo)

Teriparatide (Forteo) is a synthetic version of the human hormone, parathyroid hormone, which helps to regulate calcium metabolism. Unlike other medications for osteoporosis that reduce the resorption of bone, teriparatide very effectively promotes the growth of new bone. Forteo is self-injected into the skin. Because long-term safety is not yet established, it is only FDA-approved for 24 months of use. It reduces spinal fractures in women with known osteoporosis, but it is not known if there is a similar reduction in the risk for hip fracture. Generally, after a two-year course of teriparatide the patient is switched to bisphosphonate therapy to maintain bone density.

Denosumab (Prolia)

The latest treatment approved for osteoporosis is denosumab (Prolia), an injectable antibody that blocks a chemical messenger that plays a role in promoting bone thinning by the bone cells that are responsible for bone resorption. Prolia strengthens bone by increasing its density and reduces fractures. Prolia is administered by twice yearly injections under the skin. Denosumab is used for the treatment of postmenopausal women with osteoporosis at high risk for fracture, defined as a history of osteoporotic fracture, or multiple risk factors for fracture, or patients who have failed or are intolerant to other available

osteoporosis therapy. Denosumab can cause increased risk of infections and low blood calcium levels (hypocalcemia).

Choosing an osteoporosis medication

In choosing a medication for osteoporosis, a physician will consider all aspects of a patient's medical history as well as the severity of the osteoporosis.

If a postmenopausal woman has other menopausal symptoms such as hot flashes and vaginal dryness, HRT will be the proper choice for these menopausal symptoms as well as for the prevention of osteoporosis. After the menopausal symptoms have passed, some other nonestrogen prescription medication will be considered for the longer term.

If the prevention and treatment of osteoporosis is the only issue under consideration, then bisphosphonates such as alendronate, ibandronate, or risedronate are more effective than menopausal hormone therapy in preventing osteoporotic fractures and less likely to be associated with substantial adverse effects. So far, bisphosphonates are the most well-studied and effective category of prescription medication for treating postmenopausal osteoporosis.

A few serious esophageal conditions preclude the use of oral bisphosphonates, specifically esophageal stricture or achalasia. In these two conditions, it is likely that the bisphosphonate tablets will be retained in the esophagus and lead to esophageal inflammation, ulceration, and scarring. Caution often is advised for people with dysphagia (trouble swallowing) because the dysphagia may be a manifestation of a problem in the esophagus that will cause the bisphosphonate tablets to get stuck. Caution also is advised when there is gastritis, duodenitis, or ulcers because of the possibility that the bisphosphonate will aggravate the inflammation associated with these conditions. Any worsening of gastrointestinal symptoms should be reported immediately, but the vast majority of people tolerate bisphosphonates without symptoms when the prescribing directions are followed carefully. Fortunately, GERD or heartburn, which are common, are not reasons for withholding bisphosphonates but they are considered when selecting optimal treatment for an individual. Prescribing directions should be followed carefully. Moreover, intravenous bisphosphonates, such as zoledronate (Reclast) or injectable denosumab (Prolia), may be given to those with esophageal strictures, achalasia, dysphagia, or gastrointestinal side effects from oral bisphosphonates.

In patients with GERD or who have symptoms of heartburn, risedronate may prove to cause less irritation to the esophagus than alendronate, but now intravenous bisphosphonates, such as zoledronate may be preferred.

Calcitonin is a weaker antiresorptive medication than bisphosphonates. It is reserved for patients who cannot take or will not consider taking other medications. Raloxifene also is a weaker medication for improving bone density or preventing fractures as compared to estrogen or bisphosphonates. In patients with moderate to severe osteoporosis, it is advisable to use the more potent antiresorptive medications (bisphosphonates). In addition, the safety and effectiveness of more than three years of raloxifene, or more than 24 months of teriparatide, have not been well studied.

Estrogen replacement and raloxifene differ in their side effects and also in their effects on cholesterol levels. For example, raloxifene does not raise the "good" HDL cholesterol but estrogen replacement does. Both estrogen and raloxifene lower the "bad" LDL cholesterol.

Prevention of osteoporosis due to long-term corticosteroids

The long-term use of corticosteroids (such as prednisone, cortisone, and prednisolone) can lead to osteoporosis. Corticosteroids cause decreased calcium absorption from the intestines, increased loss of calcium through the kidneys in urine, and increased calcium loss from the bones. To prevent bone loss while on long-term corticosteroids, patients should

1. have an adequate calcium (1,000 mg daily if premenopausal, 1,500 mg daily if postmenopausal) and vitamin D intake (the actual level of Vitamin D can be measured with a simple blood test); however, calcium alone or combined with vitamin D cannot be relied upon to prevent bone loss from corticosteroids unless other prescription medications are added;
2. discuss with their doctor the use of either alendronate, risedronate, and zoledronate, which have been approved for the prevention and treatment of corticosteroid-induced osteoporosis;
3. discuss with their doctor about having a DXA bone density scan prior to beginning therapy and careful monitoring for osteoporosis during therapy.

Monitoring osteoporosis therapy

The controversy of bone density testing in patients already taking osteoporosis medication

The American Medical Association and other reputable medical organizations recommend that repeat bone density testing (DXA scans) *not* be done for monitoring osteoporosis treatment or prevention on a routine basis; it is scientifically premature to measure bone density as a way of monitoring the effects of treatment. Doctors simply do not know how to use repeated bone density measurements during therapy. Here are a few of the most important reasons:

1. Bone density changes so slowly with treatment that the changes are smaller than the measurement error of the machine. In other words, repeat DXA scans cannot distinguish between a real increase in bone density due to treatment or a mere variation in measurement from the machine itself.
2. The real purpose of osteoporosis treatment is to decrease future bone fractures. There is no good correlation between increases in bone density with decreases in fracture risks with treatment. For example, alendronate has been shown to decrease fracture risk by 50% but only to increase bone density by a few percent. In fact, most of the fracture reduction with raloxifene is not explained by raloxifene's effects on bone mineral density.
3. One density measurement taken during treatment will not help the doctor plan or modify treatment. For example, even if the DXA scan shows continued deterioration in bone density during treatment, there is not yet research data demonstrating that changing a medication, combining medications, or doubling medication doses will be safe and helpful in decreasing the future risk of fractures.
4. Even if bone density deteriorates during treatment, it is quite likely that the patient would have lost even more bone density without treatment.
5. Recent research has shown that women who lose bone density after the first year of HRT will gain bone density in the next two years of therapy, whereas women who gain in the first year will tend to lose density in the next two years of therapy. Therefore, bone density during treatment fluctuates naturally, and these fluctuations may not correlate with the prevention of fractures due to the medication.

For all of these reasons, as surprising as it may sound to many people (and even some doctors!), rechecking bone density is not at all like checking blood pressure during treatment of high blood pressure (hypertension). Routine bone density testing during treatment is unlikely to be helpful. In the future, however, if ongoing research brings new technology or new therapies, testing decisions may change.

Prevention of hip fractures in elderly people with osteoporosis

The FDA has approved hip protector garments for the prevention of hip fractures in elderly people with known osteoporosis. Brand names available include Hipsaver and Safehip. These can be helpful for selected patients who are in the nursing-home environment, although the real extent of protection against hip fractures that is gained with use of hip protectors is controversial.

Additionally, for those elderly people who use canes for walking, etc., it is essential that the rubber tips of the canes are regularly checked for any signs of wear. When this rubber wears through it presents a serious risk of causing the cane (and, therefore, the person) to slip, which can result in serious bodily harm -- including hip fracture.

Controversy

Currently, it is not clear as to how long patients with osteoporosis being treated with bisphosphonates should continue the bisphosphonate treatment. Many doctors are interrupting treatment for a "drug holiday" off of the drug as it may not be necessary after five to seven years. Guidelines for duration of treatment of osteoporosis with bisphosphonates are being developed.

What are complications of osteoporosis?

The primary complication of osteoporosis is bone fracture. This may lead to no symptoms or be associated with severe, intractable pain. Recurrent fractures are common and can lead to deteriorating skeletal structure. Occasionally, fractures of the spinal vertebrae can push bone into adjacent nerves and/or spinal cord. This can require neurosurgical intervention. Osteoporotic vertebral fractures can also be relieved by vertebroplasty (kyphoplasty) procedures whereby the collapsed vertebra is inflated by a balloon and a cement (methylmethacrylate) is injected to reform structure to the vertebra.

Repeated vertebral compression fractures can lead to severe deformity of the spine of the chest (kyphosis) that can compromise breathing along with cause extreme loss of height. This can increase the risk of problems with any respiratory infections.

What is the prognosis (outlook) for patients with osteoporosis?

The outlook for patients with osteoporosis depends greatly on where fractures occur. Additionally, if treatment is begun when the bone disease is detected early, the outcome is better.

Hip fractures are a particularly dangerous consequence of osteoporosis in the elderly. Approximately 20% of those who experience a hip fracture will die in the year following the fracture. Only one-third of hip-fracture patients regain their pre-fracture level of function. One-third of hip-fracture patients are discharged to a nursing home within the year after fracture.

Newer medications, medications with different methods of delivery, and research into the optimal management of osteoporosis will bring even better options for care for patients with osteoporosis in the future.

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