Preventing fractures in the elderly in GP practice

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Abstract

Osteoporosis is a common bone disorder that increases the risk of a fragility fracture. The elderly are prone to the development of osteoporosis and have an increased propensity to fall thereby increasing their risk of fractures. Fractures (especially hip fractures) in the elderly are associated with a high morbidity and mortality, and are also costly, accounting for large portions of health budgets. To prevent fractures it is therefore prudent to identify those with or at risk of osteoporosis and those at risk of falling. Although there is a lack of consensus on which individuals gain most benefit from Dual Energy X-ray Absorptiometry (DEXA) screening, the majority would concur that individuals with known risk factors for osteoporosis and those at risk of sustaining a fracture should undergo DEXA screening. After a diagnosis of osteoporosis, secondary causes should be excluded and appropriate therapy initiated. Therapy may include treatment of a secondary cause, non-pharmacologic and pharmacologic measures. Pharmacologic therapy has been shown to significantly decrease the risk of both vertebral and non-vertebral fractures. Individuals not diagnosed with osteoporosis but at increased risk of falls have been shown to derive some benefit from calcium and vitamin D supplementation, a weight-bearing exercise regimen, and refraining from smoking and alcohol abuse.

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Highlights

- Fractures in the elderly are associated with a high morbidity and mortality
- Many fractures are preventable
- Osteoporosis is not painful
- Pain indicates a complication, such as a fracture or degenerative disease
- Low bone mass, previous fragility fracture or propensity for falling are the three commonest risk factors for fracture
- Elderly patients should be screened for secondary causes of osteoporosis, and for other risk factors for fractures and falls
- Prevention strategies include calcium and vitamin D supplementation, weight-bearing exercises, refraining from smoking and alcohol abuse, and avoiding falls
- Various pharmacologic agents have been proven to be of benefit in the prevention and treatment of osteoporosis

INTRODUCTION

Fractures (especially of the hip) are a major cause of morbidity and mortality in the elderly. Studies indicate a mortality rate of 15 to 35% in the first year following a fracture. Among survivors of a fall, up to 35% will be disabled or unable to walk.[1] Treatment of fractures is moreover expensive, costing £1.7 billion/year in the United Kingdom and $18 billion/year in the USA.[2,3] Fractures are also major contributors to bed occupancy in hospitals.

The classical osteoporotic fractures in older individuals involve the spine, hip and wrist, but may involve the ribs, shoulder and pelvis.[4] With an increase in the older population in both developed and developing countries the burden of managing fractures, especially those of the hip, will increase. Indeed, Cooper et al. suggest that the world-wide incidence of hip fractures is likely to increase from 1.66 million in 1990 to 6.26 million in 2050, placing an

additional financial strain on health systems.[5] Therefore, the cornerstone of all care for the elderly should be an assessment of their fracture risk.

SCREENING FOR RISK FACTORS FOR FRACTURES

Three factors consistently associated with an increased fracture risk across several studies are a low bone mass, a previous fragility fracture and a propensity to fall. The risk of a fracture increases 1.4–3.0-fold for each standard deviation (SD) decrease in bone mineral density (BMD).[6] However, the Study of Osteoporotic Fractures has shown that individuals with a normal BMD may still be at risk of fractures.[7] Analysis of the data on women with fractures but without osteoporosis shows advanced age, a lack of exercise in the past year, reduced visual contrast sensitivity, falls in the past year, prevalent vertebral fractures and lower total hip BMD to be strong predictors of fracture risk, and low bone mass and propensity to fall the most predictive factors.

Low bone mass

Using BMD results obtained by dual-energy X-ray absorptiometry (DEXA), the WHO has proposed a diagnosis of osteoporosis that includes four diagnostic categories (see Table I).[6,8] Strategies to prevent fractures should aim at identifying those with a low BMD, but there is no consensus regarding whom to screen.

The American National Osteoporosis Foundation recommends routine screening with DEXA in all patients > 65 years but the recommendation is not supported by other national foundations as mass screening is not regarded as being cost effective.[6,8] It is proposed that only patients at risk of osteoporosis (see Table II and Table III) and those at risk of falls (see Table IV) undergo DEXA-screening. After making a diagnosis of osteoporosis, secondary causes must be excluded (see Table III). There is no consensus as to what constitutes a rational and cost-effective approach, but, following a comprehensive history and clinical examination, we recommend the following routine investigations: TSH, corrected calcium, parathyroid hormone, alkaline phosphatase (ALP), alanine aminotransferase (ALT), 25 hydroxyvitamin D, erythrocyte sedimentation rate (ESR), sex steroids and gonadotrophins, serum creatinine and urea, and thoracic and lumbar spine X-rays. These investigations will exclude hyperthyroidism, hyperparathyroidism, vitamin D deficiency, hypogonadism, malignancy, osteomalacia, active Paget's disease, liver disease, renal failure and asymptomatic vertebral fractures.

Further investigations should be tailored to clinical findings. A diagnosis of idiopathic (primary) osteoporosis is made on exclusion of secondary causes.

Propensity for falls

Falls typically result from the interaction of multiple and diverse, sometimes correctable, risk factors and situations (see Table IV). A risk of falling increases with an increase

Table I: WHO classification of osteoporosis

Normal	BMD T-score < 1 SD of the young adult reference mean
Osteopenia	BMD T-score > 1 SD but < 2.5 SD below the young adult mean
Osteoporosis	BMD T-score > 2.5 SD below the young adult mean
Severe osteoporosis	BMD T-score > 2.5 SD below the young adult mean PLUS One or more fragility fractures

Table II: Risk factors for osteoporosis

Genetic	Family history
Gender	Females > males
Age	Advanced age
Nutrition	Low-calcium diet High caffeine intake
Oestrogen window	Late menarche Early menopause
Habits	Smoking Alcohol abuse Sedentary lifestyle
Other	Nulliparity Low BMI Small stature

Table III: Secondary causes of osteoporosis

Endocrine	Hyperthyroidism, hyperparathyroidism, hypogonadism, Cushing's Syndrome, hyperprolactinemia, diabetes mellitus, acromegaly
Non-endocrine	
Drugs	Corticosteroids, anticonvulsants, chronic heparin use, overtreatment with thyroxine, aluminium-containing antacids, Methotrexate
Immobilisation	
Renal disease	
Liver disease	Primary biliary cirrhosis, haemochromotosis, haemosiderosis
GIT disease	In ammatory bowel disease, malabsorption, coeliac disease, gastrectomy, total parenteral nutrition
Connective tissue disease	Osteogenesis imperfecta, Ehlers-Danlos Syndrome, Marfan's Syndrome, rheumatoid arthritis
Haematopoetic disorders	Plasma cell dyscrasias, myeloprolferative disease, leukaemia, lymphoma, sickle cell disease

in the number of risk factors in an individual.

The risk of recurrent falls in community-dwelling individuals increases from 10% to 69% as the risk factors increase from one to four or more.[9]

A one-year follow-up study demonstrated an association between starting a new benzodiazepine or antipsychotic medication with very high risks (odds ratio = 11) for falls.[10] The family physician caring for older patients should include a falls assessment in their management. History and physical examination will reveal those with previous falls and those at risk of falls.[9] Medical history should include a description of circumstances surrounding the fall and any associated symptoms, a detailed review of medications, including over-the-counter medications, assessment for acute and chronic physical problems, mobility level, and function and cognitive status.[10]

Physical examination should include a check for postural changes in pulse and blood pressure, presence of arrhythmias, visual problems, gait and balance abnormalities, lower extremity strength and joint function, and neurological evaluation for focal signs, including peripheral nerves and proprioception.[10] Patients with an abnormality on examination and those who report a fall should be screened by means of the "Get Up and Go" test. The test involves observing for unsteadiness as the patient gets up from a chair without using arms, walks three metres, turns around, walks back and resumes a seated position. The process should take less than 16 seconds. Difficulty in performing this test indicates a need for further evaluation.[10]

The role of laboratory tests in fall prevention has not been well studied. It is reasonable to perform a full blood count, electrolytes, blood urea nitrogen, creatinine, glucose, thyroid function, 25 hydroxyvitamin D and vitamin B12 levels. These tests can help exclude treatable causes for falls. Those with a history of syncope will need an electrocardiogram and referral for further evaluation. Other tests including brain imaging may be considered depending on the abnormalities suggested by history and physical examination.[11]

PREVENTION OF FRACTURES

The prevention of osteoporosis begins in childhood by ensuring adequate dietary intake of calcium, adequate sun exposure, exercise, and refraining from smoking and alcohol abuse. The achievement of peak bone mass is a complicated and controversial issue but is largely determined by genetic, hormonal and environmental factors. Most osteoporosis prevention protocols focus on the following simple measures:

Adequate calcium intake

Many studies have assessed the contribution of calcium to the prevention and treatment of osteoporosis.[12] However, the results are difficult to interpret due to a high drop-out rate, a lack of uniformity in outcome measures, and different formulations and doses. A meta-analysis of these studies revealed a small but positive improvement in BMD as well as a non-significant decrease in vertebral (23%) and non-vertebral (14%) fractures.[12] The

Table IV: Risk factors for falls

Intrinsic factors	
Neurological	Stroke, Parkinson's disease, gait changes, dementia, vestibular dysfunction
Musculoskeletal	Arthritis, deconditioning, stiffness
Cardiac	Orthostatic hypotension, arrhythmias, vasovagal syncope, ischaemic heart disease
Metabolic	Hypothyroidism, hypoglycaemia, dehydration, diabetes mellitus
Medication	Sedatives, hypnotics, antidepressants, diuretics, > four drugs
Psychological	Depression, refusal to use assistive devices, overestimated ability
Extrinsic factors	
Environmental	Ground surfaces, rugs, bathroom, stairs without rails
Non-environmental	Poorly adjusted or improper walking aids, poorly fitting footwear

recommended dosage is 1000-1500 mg of elemental calcium per day. There is no convincing evidence to support a specific formulation.[12]

Adequate vitamin D intake

Vitamin D stores are maintained by diet and adequate sun exposure. The elderly are prone to vitamin D deficiency partly due to diminishing ability of the skin to convert vitamin D, especially beyond the age of 70 years, and limited exposure to the sun, especially those in institutions. A meta-analysis of studies to assess the efficacy of vitamin D for the prevention and treatment of osteoporosis found variability in study design, inconsistent results, differing methods of supplementation and varied use of calcium between studies, thus making the data difficult to interpret.[13] Yet a significant decrease was found in vertebral fractures (37-67%) and, to a lesser degree, in non-vertebral fractures (13-23%), depending on the formulation used. The recommended dosage is 400-800 IU/day, but in patients aged 70 years and over it is suggested that 800-1000 IU/day be used. No consistent evidence supports a specific formulation.[13]

Exercise

Numerous studies demonstrate a decrease in hip fractures in active compared to inactive women.[14] Weight-bearing activity (walking and weightlifting) has been shown to be more beneficial than non-weight-bearing activity (aerobics and swimming). Patients should therefore be advised to initiate an exercise pro-gramme encompassing walking or weightlifting.

Stopping smoking and/or alcohol abuse

Smoking reduces the age at which menopause occurs, increases the metabolism of oestrogen and depresses osteoblastic activity. Interestingly, moderate alcohol use has been shown to increase BMD, probably by decreasing bone remodelling.[15] In contrast, alcohol abuse causes osteoporosis by causing nutritional deficiencies, liver damage and hypogonadism, and is directly toxic to bone cells.[6]

The above therapies for the prevention of osteoporosis provide the foundation for further pharmacologic treatment of established osteoporosis. Pharmacologic agents for use in the treatment of osteoporosis can be classified as inhibitors of bone formation/turnover such as calcium, vitamin D, hormone replacement therapy, selective oestrogen receptor modulators, bisphosphonates and calcitonin or stimulators of bone formation such as recombinant parathyroid hormone and strontium ranelate.

Bisphosphonates

These drugs are extensively prescribed for the treatment of established osteoporosis. Their mechanism of action includes the ability to adsorb to bone in areas of high osteoclastic activity and inhibit osteoclast function. The drugs inhibit osteoblast apoptosis moreover, thereby promoting new bone formation. There is strong evidence for the efficacy of bisphosphonates.[16] The drugs demonstrate a significant increase in BMD and decrease in both vertebral and non-vertebral fractures in post-menopausal osteoporosis in women with or without a vertebral fracture;[17] in men with osteoporosis;[18,19] and in steroid-induced osteoporosis.[20] They also maintain their benefit without any added side-effects for at least 10 years.[21] Alendronate (Fosamax) and Risedronate (Actonel) are currently registered in South Africa for use in osteoporosis [Ibandronate (Boniva) has been submitted for registration]. Side-effects include hypocalcaemia and increased parathyroid hormone (usually transient and seldom of clinical significance); skin rash (with all bisphosphonates); oesophageal ulceration and gastrointestinal irritation (with oral forms); and fever, acute-phase reaction, bone pain, transient leucopoenia and eye inflammation (with intravenous forms). To avoid unwanted GIT side-effects, the oral forms should be taken on an empty stomach (they are poorly absorbed from the GIT) and with a full cup of water whilst sitting up. Thereafter, for 30 minutes (60 minutes if using Ibandronate) no food or drink should be taken and the patient should maintain an erect posture.

Hormone replacement therapy (HRT)

Since the publication of the Women's Health Initiative (WHI) Study, the use of HRT has become controversial. Despite the WHI being the first controlled study to show a significant improvement in osteoporosis with the use of these agents, it also revealed an increase in cardiovascular events, pulmonary embolism (PE), deep vein thrombosis (DVT) and stroke. There is a general consensus that HRT should not be used in patients over 60 years of age. In those under 60 years, HRT should only be used in individuals with no risk factors for vascular events (i.e. no diabetes mellitus, hypertension, past or family history of ischaemic heart disease or stroke, and no previous DVT or PE and is a non-smoker).

Selective oestrogen receptor modulators (SERMS)

These agents exert selective oestrogenic or anti-oestrogenic effects by binding to the oestrogen receptor in various oestrogen-dependent target tissues. They are anti-oestrogenic at the breast and oestrogenic at the uterus and bone. Since the publication of the WHI Study, their use has increased sharply. The most convincing evidence for their use in osteoporosis was obtained from the MORE Study.[22] In this study, the use of raloxifene was associated with a 38 to 52% decrease in vertebral fractures and a slight but insignificant decrease in non-vertebral fractures when compared with a placebo. This influence on

bone was accompanied by a 90% reduced risk of oestrogen-receptor-positive breast cancer[23] and no increased risk of cardiovascular or central nervous system events,[24] but was associated with an increased risk of deep vein thrombosis. Studies using tamoxifen have revealed conflicting results, with one showing an increase in fractures and another showing a decrease. Formulations include raloxifene (the only formulation registered for the prevention and treatment of post-menopausal osteoporosis), tamoxifen and toremifene. Side effects may include hot flashes, deep vein thrombosis, influenza-like syndrome, leg cramps and breast pain.

Calcitonin

No convincing evidence for use and is not recom-mended for long-term therapy.

Parathyroid hormone

Strong evidence exists for efficacy in preventing both vertebral and non-vertebral fractures in post-menopausal osteoporosis, men with osteoporosis and glucocorticoid-induced osteoporosis.[28,29,30] The National Osteoporosis Foundation of South Africa (NOFSA) recom-mends its use in the following clinical situations: 1) A low BMD and 2 or more prevalent fractures, or 2) Failed anti-resorptive therapy – i.e. after adhering to adequate anti-resorptive therapy for 12 months or more, the patient experiences: i) an incident fragility fracture, or ii) unacceptable rate of bone loss (e.g. a decrease in vertebral BMD of > or = 5% per annum) as documented on 2 or more consecutive follow-up BMD measurements.

Strontium Ranelate

This agent has a novel dual antiresorptive and anabolic action on bone. Strong evidence exists for efficacy in preventing both vertebral and non-vertebral fractures in post-menopausal osteoporosis.[31,32] Data is also emerging indicating it's efficacy in the elderly.[31,32]

PREVENTION AND TREATMENT OF FALLS

Many risk factors for falls are correctable and fall prevention is essential in instituting injury prevention. Falls intervention pro-grammes have two approaches: 1) a single-intervention strategy such as exercise, vitamin D and calcium intake or withdrawal of offending drugs, and 2) multifactorial pre-ventive programmes, including reduction and correction of the predisposing and situational risk factors. The type of intervention instituted for the individual patient is dependent on clinical assessment[9] (see Figure 1).

Single-intervention strategies

Strength and balance training

Randomised trials, meta-analyses and systemic reviews confirm that strength and balance training for older adults living in the community can reduce the risk of falls by 15%. Strength and balance training improve muscle strength, flexibility, balance, co-ordination, proprioception, reaction time and gait. Past and current physical activity is protective against hip fracture, the risk reduction being 20-70%.[11,25]

Vitamin D and calcium

Vitamin D and calcium play an essential role in bone metabolism but, vitamin D also contributes to improved muscle function. Supplementation of vitamin D in frail elderly patients for 12 weeks resulted in an improvement in muscle strength and dynamic musculo-skeletal performance. In addition, vitamin D supplementation was only effective in reducing the number of falls if taken with >500 mg/day of calcium.[25]

Expedited cataract surgery

Visual impairment, especially poor contrast sensitivity and poor depth perception, are major risk factors for falling in elderly people. Expedited surgery for cataract reduced the rate of falling by 34% in an intervention group compared with surgery-waiting controls.[26]

Hip protectors

The cause of a hip fracture in most cases is a sideways fall with direct impact on the greater trochanter. Hip protectors attenuate and divert the force and energy of the impact away from the greater trochanter. The use of hip protectors in high-risk groups is a useful adjunct to any falls and injury prevention programme. The most common problem with hip protectors is user compliance and adherence requiring continuous education and motivation of frail elderly adults for their regular use. [25]

Home hazard assessment and modification

A recent Cochrane review showed that home hazard assessment and modification that is professionally prescribed for elderly persons with a history of falling reduces the risk of falling by about 33%.[27]

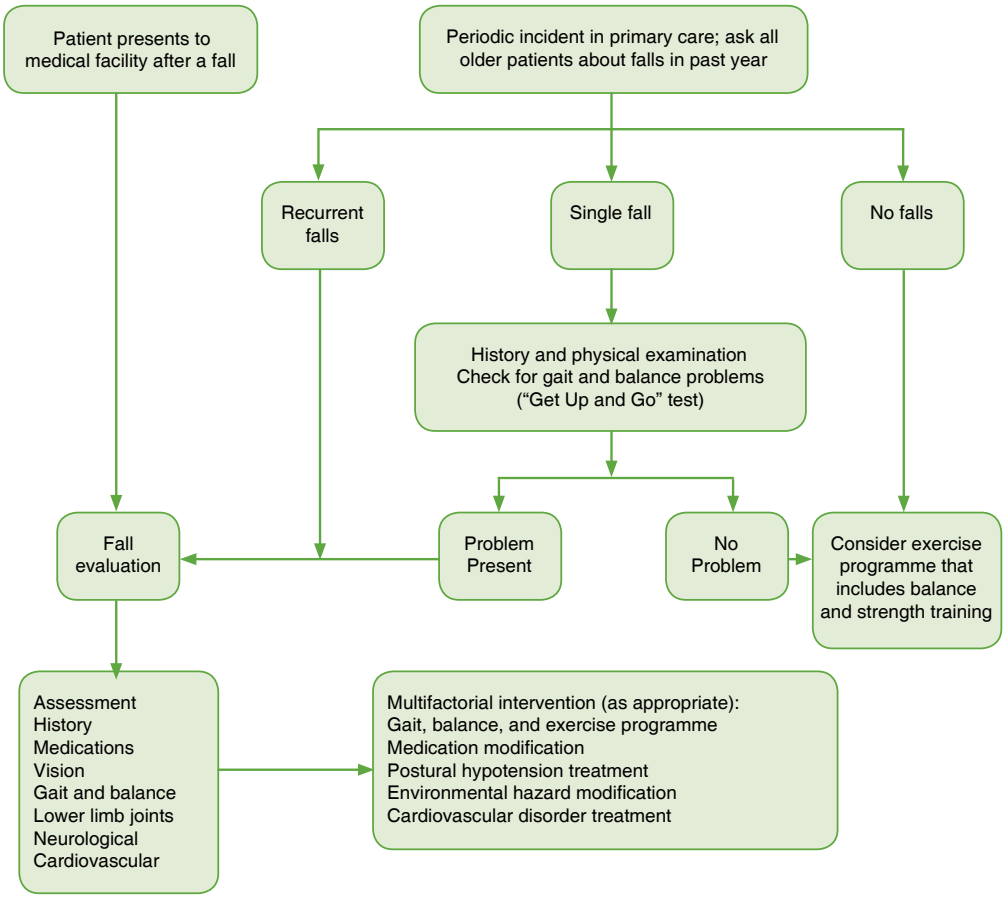
Multiple-intervention strategies

Numerous randomised controlled trials have demonstrated the benefit of multiple-intervention strategies in fall prevention in elderly adults. The content of multifaceted interventions has varied substantially from study to study, preventing direct comparison. Multifaceted interventions have included effective single interventions, such as strength, balance and gait training; mobility improvement with or without the use of aids; footwear improvement; investigation and management of untreated medical problems; medication review and adjustment; vision tests with appropriate referral; hip protectors; patient and staff education; post-fall assessment and management; and environmental and home risk assessment.[27]

CONCLUSIONS

Osteoporosis and its complications are common in the general popu-lation, but especially in elderly persons. With proper education and management, both osteoporosis and falls are preventable, thereby preventing fractures.

Figure 1: Algorithm for the assessment and management of falls in older persons



Source: American Geriatrics Society, British Geriatrics Society, American Academy of Orthopaedic Surgeons Panel of Falls Prevention. Guidelines for prevention of falls in older persons. J Am Geriatr Soc 2001;49:666, with additional information from reference 10.

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Ⓟ This article has been peer reviewed

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