European Geriatric Medicine 1 (2010) 15–21

Available online at ScienceDirect
www.sciencedirect.com

Elsevier Masson France
EM|consulte
www.em-consulte.com

Hot topic in geriatric medicine

Management of the oldest old with osteoporosis

R. Rizzoli *

Division of Bone Diseases, Department of Rehabilitation and Geriatrics, Geneva University Hospitals and Faculty of Medicine, rue Gabrielle-Perret-Gentil 24, CH-1211 Geneva 14, Geneva, Switzerland

ARTICLE INFO

Article history:
Received 3 November 2009
Accepted 23 December 2009
Available online 25 February 2010

Keywords:
Osteoporosis
Hip fracture
Falls
Frailty
Nutrition
Bisphosphonate
Strontium ranelate
Teriparatide
Vitamin D supplementation

ABSTRACT

The incidence of osteoporotic fracture increases with age; the median age for hip fracture, the most serious manifestation of osteoporosis is approximately 83 years. Osteoporotic fracture risk is multifactorial, and is determined by the balance between bone strength and the propensity for falling. Frailty is an independent predictor of falls, hip fractures, hospitalisation, disability and death in the elderly that guides for clinical decision-making, and may emerge as a therapeutic target. Non-pharmacological strategies to reduce fall risk can contribute to prevent osteoporotic fractures. Weight-bearing exercise and balance training programmes are recommended. Nutrition, particularly dietary proteins are of importance in preventing falls and fracture, as well as in fracture rehabilitation. Vitamin D and calcium supplementation is effective in reducing both falls and osteoporotic fractures, including hip fractures. Specific efficacious anti-osteoporosis drugs are underused. The evidence base for the efficacy of most such drugs in the very elderly is incomplete, particularly with regard to nonvertebral and hip fractures. Nonadherence to treatment is a substantial problem, which precludes efficacious therapeutic regimens to fulfil their goals.

1. Introduction

The lifetime risk of experiencing a fracture since the age of 50 is 51% in women and 20% in men [1]. The incidence of vertebral and especially hip fractures increases steeply with age [2]. Hip fractures are generally regarded as the most serious manifestation of osteoporosis, associated with substantial morbidity and mortality [3–5]. Over 90% of hip fractures require surgical treatment. The incidence of hip fracture increases exponentially with age in women between 60 and approximately 85 years [4,6], beyond which it increases more slowly. Hence, 60% of hip fractures in women occur after the age of 80 years, and the median age for hip fractures in women is approximately 83 years [7]. Up to 40% of hip fractures concern patients living in nursing homes [4]. This is probably related to advanced age and to a high prevalence of comorbidities requiring long-term care. Moreover, this population is at high risk of recurrent falls. Mortality after hip fracture is higher in the general male population, with a life expectancy approximately 7 years shorter than unfractured. Given the reduction of life expectancy as a consequence of hip fracture, the proportion of the years of life lost is significantly higher in men than in women (70 vs. 59%) [5].

Patients with a fracture are at markedly elevated risk of a second fracture [8,9]; nonetheless, the interval between fractures generally seems sufficient for interventions aimed at reducing the risk of subsequent fractures to be effective [10,11].

The diagnosis of the disease relies on the quantitative assessment of bone mineral mass/density, which represents so far one major determinant of bone strength and thereby of fracture risk. However, only approximately half of fragility fractures occur in women meeting current criteria for osteoporosis based on BMD [12,13]. Part of this discrepancy may be explained by the fact that many osteoporotic fractures are precipitated by falls [14]; for instance, some 98% of hip fractures are the result of falls. Thus, the risk of osteoporotic fracture seems to be determined by the balance between bone strength and propensity for falling (Fig. 1).

2. Falls

Falls and fall-related injuries are common in elderly people [15]. It is estimated that 30 to 40% of generally healthy, community-living persons aged $\geq$ 65 years experience a fall in any given year, and the rates are higher for those resident in nursing homes and persons aged $\geq$ 75 years [16]. The incidence of falls among women increases sharply with age. One of the most powerful risk factor is muscle weakness, followed by a history of falls and gait deficit. Some medications may increase fall risk, including psychotropic drugs such as benzodiazepines, and cardiovascular drugs such as anti-arrhythmics, digoxin, and diuretics [17,18]. Environmental factors such as poor lighting, loose or frayed carpets, and trailing electrical cables may also increase the risk of falling [16] (Table 1).

* Tel.: +41 22 372 99 50; fax: +41 22 382 99 73.
E-mail address: Rene.Rizzoli@unige.ch.

1878-7649/$ – see front matter
doi:10.1016/j.eurger.2009.12.003

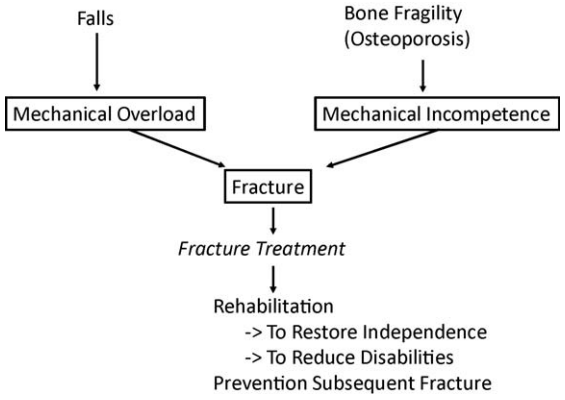

Fig. 1. Pathogenesis of osteoporotic fracture.

Given the diversity of factors that may affect fall risk, a wide range of interventional strategies to prevent falls has been explored. Gait training, exercise programmes, advice on use of assistive devices, review of existing medication, modification of environmental hazards, and the wearing of hip protectors have all been evaluated individually or as components of a multifactorial interventional strategy [16]. However, the studies are often small with varying methodology and criteria for selection of participants.

A recent Cochrane systematic review concluded that multifactorial programmes, and exercise programmes aimed at increasing muscle strength and improving balance, could significantly reduce the rate and risk of falls [19]. This review also showed that home safety interventions were effective in those at higher risk of falling and those with severe visual impairment.

An interdisciplinary assessment and referral programme was effective in reducing the risk of falling in community-dwelling individuals aged ≥ 65 years in the United Kingdom [20]. But, a subsequent study in the Netherlands, based on the same intervention programme but integrated into routine health care, was not effective [21], emphazising the potential difficulties of implementing such programmes in clinical practice as opposed to a research setting.

Different types of fall-prevention interventions were evaluated in a recent randomised trial [22], comparing education (visits and pamphlets giving information on exercise, use of walking aids, and home environmental improvements); home safety assessment and modification (safety assessments and up to 14 inexpensive home modifications carried out); or exercise training (individualised programme). According to quality-of-life and functional assessments, exercise training was superior to the other interventions.

Table 1
Risk factors for falls in the elderly, derived from 16 published studies.

Rank	Risk factor	Mean odds ratio or relative risk ratio[a]
1	Muscle weakness	4.4
2	History of falls	3.0
3	Gait deficit	2.9
4	Balance deficit	2.9
5	Use of an assistive device	2.6
6	Visual deficit	2.5
7	Arthritis	2.4
8	Impaired activities of daily living	2.3
9	Depression	2.2
10	Cognitive impairment	1.8
11	Age >80 years	1.7

Modified from Amer Ger 2001.

[a] Odds ratio for retrospective studies, relative risk ratio for prospective studies.

A meta-analysis evaluating the most effective training programme in reducing falls in the elderly showed that patients who undertook exercise programmes had lower fall rates than those who did not. The largest reductions were found in programmes with a high dose of exercise and in those which involved balance training. Exercise programmes that did not include walking reduced fall rates more than those that involved walking. The negative influence of walking on fall rate may be due to time spent walking taking the place of balance training. However, walking programmes have demonstrated other health benefits, including preventing bone loss in postmenopausal women [23]. Exercise training can also be effective in the very elderly. Indeed, a home exercise training programme reduced the number of falls by 35%, and in terms of injury prevention, participants aged ≥ 80 years benefited significantly more than those aged 65 to 79 years [24].

Whole body vibration may provide a means of reducing fall risk that is more acceptable to some elderly people than conventional exercise. However, to date no randomised controlled trial has assessed its effect on the numbers of falls.

Early studies suggested that wearing hip protectors reduced the incidence of hip fracture in elderly people living in institutional care. However, recent systematic reviews have indicated that hip protectors are not effective in community-dwelling individuals, and have cast doubt on their effectiveness in those living in institutions [25,26].

3. Nutrition

Nutritional deficiencies play a significant role in osteoporosis and fracture pathogenesis [27]. Undernutrition is often observed in elderly, and it appears to be more severe in patients with hip fracture than in the general aging population. A low protein intake could be particularly detrimental for the conservation of bone integrity with aging [28]. Protein undernutrition can favor the occurrence of hip fracture by increasing the propensity to fall as a result of muscle weakness and of impairment in movement coordination, by affecting protective mechanisms, such as reaction time, muscle strength, and thus reducing the energy required to fracture an osteoporotic proximal femur, and/or by decreasing bone mass [29]. Furthermore, a reduction in the protective layer of soft tissue padding decreases the force required to fracture an osteoporotic hip.

In a prospective study carried out on more than 40,000 women in Iowa, higher protein intake was associated with a reduced risk of hip fracture. The association was particularly evident with protein of animal rather than vegetal origin [30]. Regarding the relation with bone mineral mass, there is a positive correlation with spontaneous protein intake [28,31]. In a longitudinal follow-up in the frame of the Framingham study, the rate of bone mineral loss was inversely correlated to dietary protein intake [32]. Increasing protein intake has a favorable effect on BMD in elderly receiving calcium and vitamin D supplements [33]. Taken altogether, these results indicate that a sufficient protein intake is mandatory for bone health, particularly in elderly.

Undernutrition is linked also to the concept of frailty, which has received increasing attention in recent years [34]. Frailty involves a decreased reserve or resistance to stressors, resulting in increased vulnerability to adverse outcomes including falls, disability, dependency, and mortality [35]. Frailty involves also chronic undernutrition, sarcopenia, and reduced total energy expenditure. Low scores (<27 points) on the Mini-Nutritional Assessment are associated with a two-fold increase in the risk of osteoporosis [36].

An operational definition of frailty has been proposed by Fried et al., and is based on five characteristics: unintentional weight loss, muscle weakness, reduced energy and endurance, slowness of gait, and low physical activity level [37] (Table 2). People with none