

Public health impact of osteoporosis in older age

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Abstract

The population of elderly people (over 65 years of age) is constantly growing in the majority of western societies. This is due to the advances in medicine and the increasing awareness of healthier lifestyles during the last several decades. It is predicted that by the year 2030 there will be 70.2 million people aged 65 or older. Osteoporosis is the most common type of bone disease. The leading causes of osteoporosis are a drop in estrogen in women at the time of menopause, and a drop in testosterone in men. Women aged over 50 and men aged over 70 have a higher risk for osteoporosis. Osteoporotic fractures are one of the most common causes of disabilities, and are a very costly burden on the budgets of health care systems in many regions of the world. The fractures are caused especially following low-energy trauma (injury from a small force, e.g. after falling from a height). The most common osteoporotic fractures are: vertebral fractures, fractures of the forearm, proximal end of the femur fractures, and the proximal end of the humerus. Research on the basis of domestic and foreign literature and the results of their observations are presented, and the principles of epidemiology for the identification and treatment of osteoporotic fractures. Consciousness of serious risks related with osteoporotic fractures should lead to implementation and propagating more active preventive activity for patients of old age. According to the WHO, IOF and EFORT, a doctor admitting a patient with an osteoporotic fracture should not only treat the fracture itself, but also implement preventive procedures.

Key words

adults, osteoporosis, fractures

INTRODUCTION

The population of elderly people (over 65 years of age) is constantly increasing in the majority of western societies. This is due to the advances in medicine and the increasing awareness of healthier lifestyles during the last several decades [1]. It is predicted that by 2030, there will be 70.2 million people aged 65 or older [2]. Health problems among the elderly may be a part of the chronologic aging process, or depend upon heredity, lifestyle, and environmental factors [1]. The past few years have also shown an increase in geriatric victims of crime in the home and on the streets [1]. The most common medical problems at this stage of life are: hearing loss, sight loss, slowed movements, fractures, senility, loss of bowel and bladder control. Hearing loss requires special consideration during communicating with the patient: speaking slowly and clearly, directly into the patient's ear or maintaining eye contact while talking to the patient. For the problem with sight loss, especially connected with slowed movement, a helping hand or supporting arm can be the solution.

Fractures at elderly age occur because of the loss of calcium, and result from falls, although they may also be result of minor stroke, heart attack or confusion that took place before the fall. Senility at old age may include: loss of short-term and/or long-term memory, confusion, inability to follow direction, and sometimes hostile behaviour. It is especially difficult with the patient suffering from Alzheimer's disease, who may not be able to understand actual words. This

requires a gentle and caring approach. Loss of bowel and bladder control is a common problem in the elderly, and can also be distressing and embarrassing for both the patient and the medical personnel; however, it should never interfere with patient care [3].

Aging in the elderly. Human aging is a natural process of progressive deterioration in the body's ability to function and may be observed in different organs and systems. In the elderly, lung function decrease results in a reduction in the total volume exchange that causes a lowered level of oxygenation. The patient has to compensate for this by an increase in respiratory rate. Pneumonia and other infectious diseases are likely to occur due to diminished cough reflex and lower ability to clear secretions. The lowered circulation of the blood caused by coronary artery occlusion (a thickening and loss of elasticity of arterial walls) in the elderly may lead to elevation of blood pressure that not only affects vital organs but is also a cause of heart disease. The heart itself shows a decrease in rate, strength of contraction, compliance, valvular efficiency and stroke volume, all of them leading to the reduction of circulation and blood oxygen levels. The described changes in circulation, plus loss of cells in certain areas of the brain, results in the diminished mental capacity observed in elderly patients. There are also changes observed in the senses, such as: deficits in hearing, eyesight, sensory perception and slowing of sensory responses. Changes in the renal system may result in fluid and electrolyte disturbances. Reduced filtration and ability to excrete urine is also observed.

In the elderly, a decrease in total skeletal muscle weight and strength, as well as a decreased density of some bones, is evident. Bones become less pliant, more brittle and easily broken. A geriatric patient is also less able to fight off infection

due to changes in the immune system. The majority of elderly patients may have at least one chronic disease, some of them may suffer from multiple conditions such as: hypertension, arthritis, coronary diseases etc [1,2]. Although geriatric emergencies are most commonly medical in nature (the leading causes of death are coronary artery disease, cancer and stroke) trauma is the fifth leading cause of death in this group of patient, and trauma deaths account for 25% of all of the trauma deaths nationwide [1,2]. Among the elderly, traumatic falls are the leading cause of trauma death and disability. Motor vehicle trauma takes the second place (an elderly patient is five times more likely to be fatally injured in a car crash than a younger driver). Next come pedestrian accidents, being struck by a car, and burns resulting in mortality, serious injury, and disability at this age [1].

Characteristics of osteoporotic fractures. Epidemiological data show that in Poland, more than 25% of the population are aged over 50, in danger from osteoporotic fractures and fractures of the root of the thigh bone constitutes 9% of reasons of hospitalizations in orthopedic wards. In the United States, osteoporosis is considered to be the major threat to public health for 44 millions inhabitants, of whom 68% are women. One of every two women and one in four men over the age of 50 will have a fracture related to osteoporosis [4]. This is the cause of 1.3 million fractures a year, including 500 thousand spinal cord fractures, 250 thousand thigh bone fractures and 240 thousands antibrachial bone fractures [5]. Researchers estimate that about one out of five American women over the age of 50 have osteoporosis. About half of all women over the age of 50 will have a fracture of the hip, wrist, or vertebra (bones of the spine) [7]. White women are at higher risk for osteoporotic fractures than white men, and African Americans of both genders [5]. Asian women are also at increased risk [8].

According to a World Health Organization report, the number of thigh bone fractures worldwide will amount to four millions in 2025 (1.6 mil. at present) and over 6 millions in 2050. As present data show, if proper preventive actions are not taken, osteoporotic fractures and their causes will occur more frequently [5, 6, 9]. The United States National Institutes of Health define osteoporosis as a 'skeletal disorder characterized by compromised bone strength predisposing a person to an increased risk of fracture' [4]. Osteoporosis is the result of excessive resorption over formation of bones. After reaching a peak mass (at age of about 30) bone metabolism stabilizes and the processes of formation/resorption remain in balance. After the age of 40, bone formation ceases and a resorption process takes over, causing loss of bone mass. In this mechanism, an organism loses about 0.5–1.0% of minerals yearly. In osteoporosis the loss of bone mass reaches 2–5% or more. The disease occurs most frequently in postmenopausal women, sedentary or immobilized people, and patients on long-term steroid therapy [2]. The strength of the bones is connected with bone density and bone quality. Bone quality refers to bone structure (micro-architecture and mineralization), that deteriorates. Bone density is the result of interaction between bone mass, new bone formation, and bone desorption. According to the World Health Organization, a 10% drop in bone density is associated with a 20% increase in the risk for fracture. Bones of a healthy human being are mechanically resistant and break only as a result of a brute force (e.g. car crash). In

osteoporosis, bones become more porous, low density, fragile and weakened. It is so weakened that it can break during every-day activities (e.g. while walking), after passing certain breakage threshold.

In terms of trauma, osteoporotic fractures are one of the most frequent causes of disabilities and are a very costly part of the budgets of health care systems in many regions in the world (e.g. over \$10 million in the United States) [5]. Most often, the fractures occur as the result of a low-energy injury (injury of low force, e.g. fall from a low height). Such fractures can occur in the case of persons in their 60s. 'Fractures are a clinical symptom of osteoporosis and serious factor for further fractures in the future' [10, 11]. Falls are one of the main causes of disabilities and constitute 25% of all causes of death in cases of persons aged over 75. About 40% of persons over 60 and 50% of healthy people aged over 80 suffer from a fall at least once a year. Falls are a direct cause of 100% of radial bone fractures, 90% of neck of femur fractures and 25% of spinal cord fractures [10, 12, 13]. The risk of osteoporotic fractures is higher in the case of women – 46.4% for 50-year-old women and 22.4% for 50-year-old men. After fractures of the end of the thigh bone of elder people, 20% of women and 30% of men die from complications, and 50% of those who survive becomes disabled. The 25% of women aged over 50, suffer from spinal cord fractures, 60% of which is asymptomatic. Fractures of the end of a thigh bone occur in case of 0.25% of women (from 0.02% of 35-year-old women to 3% of 85-year-old women) [12, 14].

The most frequent osteoporotic fractures are: spinal cord fractures (vertebral bodies), fractures of further sections of antibrachial bone, fractures of the end of a thigh bone (fractures of neck of femur, through- and trans-trochanteric fractures of the thigh bone) – so-called hip fractures, fractures of the close end of a humeral bone – so-called shoulder fractures, fractures of ribs, pelvis fractures, fractures of the close end of a tibial bone [10, 15]. Vertebral bodies fractures are also called compacted spinal cord fractures [15]. There are two types of spinal cord fractures: stable and unstable [16]. Stable fractures are characterized by trabecular bone compression and wedge-shaped deformation of the vertebral body, together with limiting plates impairment. Parts that are not impaired are intervertebral discs, back vertebra wall and spinal cord ligament. Unstable fractures occur as a result of a bending-rotary mechanism, characterized by a subluxation within spinal cord's locomotor segment with vertebral canal contraction, breakage of the back ligament apparatus, and impairment of the back wall of the vertebral centrum and intervertebral disc. Vertebrae that most often are fractured are the 12 thoracic vertebra and 1st, 2nd and 3rd lumbar vertebrae. This is related with the higher mobility of lumbar vertebrae, as the thoracic vertebrae are stabilized by the thoracic cavity [16]. Vertebral body fractures, which are related with osteoporotic changes in bones, result from minor injuries that may occur during everyday activities: getting up, sinking into chair, tripping or even sneezing. Only 25% of fractures result from falls [11, 17].

The most frequent localizations of osteoporotic fractures are the Th8 – Th12 vertebrae, which include wedge fractures and biconcave fracture [16]. Osteoporotic fractures of vertebral bodies are stable fractures, but are also related with another fracture risk (four times higher than in case of a person without past fractures). These are fractures showing no clinical symptoms in 60% of patients. Clinical symptoms

include sharp pain, easy to locate, local pressure pain, and sometimes radicular syndrome. Vertebral body fractures manifest themselves by an increase of thoracic kyphosis i.e. back rounding, the so-called "widow's hump" [16]. The diagnosis of osteoporotic fractures should include, apart from anamnesis, conventional X-ray examination [12]. The treatment of fractures is most often conservative and sometimes operational. Conservative treatment consists in dressing with a plaster jacket in order to limit spinal cord movements and decrease pain [2, 16]. Long-term jacket wearing is harmful and causes the risk of amiotrophy and further osteoporosis. Plaster jackets are not recommended in cases of osteoporotic fractures [12], multiple bodies fractures, for bedridden patients, and patients with respiratory disorders. During the period just after an injury, intensified pain is often observed and it is suggested that patients should be hospitalised for a period of three to five days, analgesic treatment applied with non steroid anti-inflammatory medicines and opioids. Operational treatment consists in filling the interior of the vertebral body with bone cement via a needle. Sometimes, high treatment costs limit availability of this method [15]. After a fracture, rehabilitation period consists in muscle training in order to prevent spinal cord deformations, practice in movements coordination, physiotherapy and acupuncture [18]. Treatment prognoses and results are at good level [15].

Fractures of the distal radial bone, or so-called 'fracture in a typical place', occur as a result of fall from body height and attempt at arm support [15]. There are two types of such fractures: Colles' fracture, when a person falls on an outstretched arm, and Smith's fracture, when a person falls on a flexed wrist [16]. Colles' fractures constitute up to 90% of all wrist fractures, when the arm was in the flexed-back position. Fracture of distal radius bone is diagnosed on the basis of pain at wrist section, painful movement limits, and wrist's sensitiveness and oedema. The fracture is diagnosed on the basis of an X-ray [16].

Most often, the treatment of wrist fractures is based on conservative treatment, i.e. local anaesthesia, manual reposition of splinters and dressing with plaster (used in the case of table fractures). Unstable fracture should be treated operationally. Nowadays, operational treatment is used for wrist fractures (reposition and through-skin stabilizing with metal pins). The aim of this treatment is faster rehabilitation of an impaired limb after adhesion, and shorter or even lack of plaster use. Prognoses and results of such treatment are generally at a good level [15, 16]. Complications include growth disorders (sporadically) and carpal tunnel syndrome, i.e. median nerve compression, sinew impairments and inflammations of vagina tendinis musculi flexoris pollicis longi [16]. About 30% of fractures are complicated with Sudeck's atrophy [11]. Anti-complication prevention is based on cutting the plaster, raising the limb, and isometric practice of forearm muscles. After removing the plaster, the range of practice should be extended with wrist and elbow joint active movements and active resistive exercises [19, 20]. Fractures of the volar end of the thigh bone can be divided into fractures of thigh bone head, thigh bone neck and trochanteric. Thigh bone neck fractures are very frequent in persons aged over 60 and account for 30% of all fractures (even 60% in women), and are the most serious result of osteoporosis. They can result in very serious complications, such as: pneumonia, cystitis, circulatory-respiratory failures,

brain congestions, protein management disorders, and bedsores. Commonly called a 'hip fracture', it can result from two mechanisms: direct (fall from body height) or indirect (impact). Complications include lack of adhesion and aseptic necrosis of the head of the femur [16]. 80% of trochanteric fractures concern people at older age. Trochanteric fractures can be divided according to the location of the fracture: intertrochanteric, transtrochanteric and subtrochanteric. Trochanteric fractures are located in the area between the hip articular capsule and three centimeters below the lesser trochanter. Fracture gap passes through the trabecular bone, close to the thigh bone. Good perfusion of this area provides proper healing of fractures but when a person suffers from osteoporosis, prognoses are not optimistic. The limb is shorter and externally rotated after fracture [16]. In the case of trans- and intertrochanteric fractures, it is suggested to anastomose bones in such way that the limb can be loaded as fast as possible. If the fractures cannot be operated on, using direct traction is suggested [12].

About 50% of patients suffering from fractures of the neck of the femur require long-term care, and a half of them also care in a specialized medical centres [21]. Hip fractures are intrinsically painful and limitation of movements occurs. The most essential analysis is based on an X-ray of the hip joint. Operational treatment is suggested which enables fast recovery. Conservative treatment is related with the risk of high death rate (60% of patients). The treatment uses operational synthesis. In the case of neck of femur fractures, using total hip arthroplasty is suggested. Anti-thrombi prophylaxis should be implemented [15]. The strategy of thigh bone fractures treatment is focused on the fastest possible perpendicularity of a patient [12]. Shortly after an operation, therapists use walking for the relief of a limb, active exercises and movements coordination exercises [15, 18]. Due to the high mortality rate, operational treatment is an optional method and the fracture itself is regarded as life threatening. Patients with neck of femur fractures, who cannot be treated operationally, should be treated conventionally, with fast perpendicularity and implementation of chair and bed mode of life [12].

At old age, a thigh bone fracture is a serious problem. 15–20% of people die during first three months after a trochanteric fracture and 10% after neck of femur fracture. About 65% of persons return to the state before a fracture [12, 16, 21]. Fractures of the upper extremity of the humerus apply to its head, anatomical neck, surgical neck, greater and lesser tubercles. Humerus surgical neck fractures (sometimes the anatomical as well) are frequent osteoporotic injuries, especially in persons in their 60s. Generally, they occur due to an indirect mechanism – fall on an upper limb. Pain and oedema are present and there are difficulties with movements [16]. At the site of the fracture, the limb should be immobilized, best by bandaging it to the thoracic cavity, immobilizing by a cloth or Kramer's splint [22, 23]. An X-ray picture is the deciding issue in diagnosis. A fractured shoulder is mostly treated conservatively; the limb should be immobilized in plaster or stabilizer for a period of three or four weeks. Where substantial splinters, dislocations and comminuted fractures occur, operational treatment is suggested with the use of screws and intramedullary nailing. In 6% of cases, complications occur, especially growth disorders and limited limb movements [15, 20].

CONCLUSIONS

Osteoporotic fractures are becoming an increasingly serious medical problem. The risk of another fracture increases about two to tenfold after the first [12]. Other risk factors, with the exception of previous fracture, are as follow: low body weight, estrogen deficiency, white race (although the risk for Afro-Americans is also substantial) family history of osteoporosis, and smoking [4]. Elderly persons are rightfully concerned about the loss of independence associated with fractures. Six months after a hip fracture, many older persons still require assistance with the activities of daily living [24]. Furthermore, over 10% of persons with hip fractures die; in the United States alone, hip fractures are responsible for 31,000 deaths each year [25]. According to suggestions by the World Health Organization (WHO), International Osteoporosis Foundation (IOF) and European Federation of Orthopedics (EFFORT), the general rules of procedures for people suffering from osteoporotic fractures include: diagnostics and treatment, informing the patient about osteoporosis and future risk of a fracture risk, implementation of fall preventive procedures, osteoporosis diagnostics, and osteoporosis treatment [6, 9, 12, 26]. Unfortunately, the criteria for identifying, for example, women at menopause at the greatest risk for bone loss and fractures one to two decades later, are unclear. There are also several agents that inhibit bone resorption: calcium, vitamin D, calcitonin, bisphosphonates, and estrogen [4]. The role of some of them in prophylaxis protocols for clinical management have not yet been established. Nevertheless, a routine bone density screening for women aged 65 years or older are recommended by the United States Preventive Services Task Force, and should be introduced everywhere.

Consciousness of the serious risks related with osteoporotic fractures should lead to the implementation and propagating of more active preventive activity for patients of old age. According to the World Health Organization (WHO), International Osteoporosis Foundation (IOF) and European Federation of Orthopedic (EFFORT), a doctor admitting a patient with an osteoporotic fracture should not only treat the fracture itself, but also implement preventive procedures [6, 9, 12, 26]. One of them is a change of a lifestyle that includes *giving up cigarette smoking*, curtailing excessive alcohol intake, exercising regularly, and consuming a balanced diet with adequate levels of calcium and vitamin D, which are considered to be beneficial and not only for patient with osteoporosis.

REFERENCES

- Johansson J, et al. Prehospital Trauma Life Support (PHTLS) training of ambulance caregivers and impact on survival of trauma victims. *Resuscitation* 2012; 83(10): 1259–1264.
- Henry JA, Reingold AL. Prehospital trauma systems reduce mortality in developing countries: a systematic review and meta-analysis. *Journal of trauma and acute care surgery* 2012; 73(1): 261–268.
- Wooster M, et al. End-of-life decision-making for patients with geriatric trauma cared for in a trauma intensive care unit. *American Journal of Hospice and Palliative Medicine* 2018, 1049909117752670.
- Mack DE, Wilson PM, Gunnell KE. Land of confusion: unpacking the relationship between physical activity and well-being in individuals living with osteoporosis. *International Review of Sport and Exercise Psychology* 2017; 10(1): 212–229.
- Gennari L, Rotatori S, Bianciardi S, Nuti R, Merlotti D. Treatment needs and current options for postmenopausal osteoporosis. *Expert opinion on pharmacotherapy* 2016; 17(8): 1141–1152.
- Vellas B, Sourdet S. World Congress on Osteoporosis, Osteoarthritis and Musculoskeletal Diseases (WCO-IOF-ESCEO 2017): World Health Organization (WHO) Abstracts. *Osteoporos Int.* 2017; 28(1): S83–S85.
- Sharif A, Hussain M, Ilyas S. Role of Dietary Pattern in Prevention of Osteoporosis in Post Menopausal Females. *Cell.* 2017; 331, 4838518.
- Pawłowski W, Goniewicz K, Goniewicz M, Czernski R. Skull fractures in car accidents: Types and Causes. *Journal of Education, Health and Sport.* 2018; 8(3): 397–409.
- Badurski JE, et al. Zalecenia Polskiej Fundacji Osteoporozy i Polskiego Towarzystwa Osteoartrologii wobec osteoporozy w oparciu o stanowisko Światowej Organizacji Zdrowia (WHO) i Międzynarodowej Fundacji Osteoporozy (IOF). *Ortopedia, Traumatologia, Rehabilitacja* 2007; 9 Supl. 3: 1–20.
- Marcinowska-Suchowierska E, et al. Treatment of osteoporosis in Poland—availability and reasons for lack of implementation. *Postępy Nauk Medycznych.* 2015; 12: 879–885.
- Cauley JA. Osteoporosis: fracture epidemiology update 2016. *Current opinion in rheumatology*, 2017; 29(2): 150–156.
- Baim S. The Future of Fracture Risk Assessment in the Management of Osteoporosis. *Journal of Clinical Densitometry*, 2017; 20(3): 451–457.
- Fahlström G, Kamwendo K, Forsberg J, Bodin L. Fall prevention by nursing assistants among community-living elderly people. A randomised controlled trial. *Scandinavian journal of caring sciences*, 2018; 32(2): 575–585.
- Harvey NC, et al. Falls Predict Fractures Independently of FRAX Probability: A Meta-Analysis of the Osteoporotic Fractures in Men (MrOS) Study. *Journal of Bone and Mineral Research* 2018; 33(3): 510–516.
- Blauth M, Kates SL, Nicholas JA (Eds.). *Osteoporotic Fracture Care: Medical and Surgical Management.* New York, 2018.
- Gaździk ST. *Ortopedia i traumatologia.* Warszawa 2009.
- Fox S, Spiess M, Hnenny L, Fournery DR. Spinal Instability Neoplastic Score (SINS): Reliability Among Spine Fellows and Resident Physicians in Orthopedic Surgery and Neurosurgery. *Global spine journal* 2017; 7(8): 744–748.
- Wright A, et al. The influence of a full-time, immersive simulation-based clinical placement on physiotherapy student confidence during the transition to clinical practice. *Advances in Simulation* 2017; 3(1), 3.
- Cosman F, et al. Clinician's guide to prevention and treatment of osteoporosis. *Osteoporosis international* 2017; 25(10): 2359–2381.
- Aswathikutty A, Marceles W, Stansfeld SA, Bernabé E. Obesity, physical activity and traumatic dental injuries in adolescents from East London. *Dental traumatology* 2017; 33(2): 137–142.
- Kruczyński J, et al. Wyniki leczenia operacyjnego złamań bliźszego końca kości udowej u chorych 90 letnich i starszych. *Ortopedia, traumatologia, rehabilitacja* 2008; 10(4): 333–344.
- Fox N, et al. Evaluation and management of blunt traumatic aortic injury: a practice management guideline from the Eastern Association for the Surgery of Trauma. *Journal of Trauma and Acute Care Surgery* 2015; 78(1): 136–146.
- Włoszczak-Szubzda A, Jarosz MJ, Goniewicz M, Goniewicz K. Evaluation of communication and acceptance of the patients by medical personnel. *Roczniki Państwowego Zakładu Higieny* 2016; 67(4): 427–433.
- Guay J, Parker MJ, Gajendragadkar PR, Kopp S. Anaesthesia for hip fracture surgery in adults. *Cochrane Database of Systematic Reviews*, (2). Art. No.: CD000521. doi: 10.1002/14651858.CD000521.pub3.
- Bliuc D, Alarkawi D, Nguyen TV, Eisman JA, Center JR. Risk of subsequent fractures and mortality in elderly women and men with fragility fractures with and without osteoporotic bone density: the Dubbo Osteoporosis Epidemiology Study. *Journal of bone and mineral research* 2015; 30(4): 637–646.
- Shuler MD, Franklin D, Scott MD, Wilson-Byrne MD, Morgan MR, Morgan L. Improving Rural Bone Health and Minimizing Fracture Risk in West Virginia: Validation of the World Health Organization FRAX® Assessment Tool as a Phone Survey for Osteoporosis Detection. 2016.