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Aging of balance and risk of falls in elderly

Abstract

Aging is a universal, irreversible and individual process that causes morphophysiological changes in the musculoskeletal systems, central nervous system and sensory systems (visual, vestibular and proprioception), causing greater risk of falls. The falls have a high prevalence and have become an important public health problem due to the high economic and functional costs they represent in the elderly. To avoid these events it is important to know the anatomophysiological changes associated with aging and plan health strategies where bone, muscle, somatosensory (proprioceptive) and cognitive stimulation is incorporated with the aim of avoiding functional impairment and disability.

Keyworks: Aging, aged, falls, balance

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Introduction

Aging is a biological, universal, individual, asynchronous and natural process that causes morphophysiological changes on body systems.[1] Currently the literature has shown that aging causes alterations in the musculoskeletal system, generating important modifications on motor skills necessary for the execution of functional activities such as balance, posture and gait.[1,2] These changes and their consequences have been strongly associated with an increase in the risk of falling.

A fall is defined as a sudden and unexpected event that precipitates the individual to the ground against their will, becoming an important public health problem due to its high frequency in the elderly population.[3] Falls represent high economic costs for countries, and cause important health consequences, such as an increase in the number of hospitalizations, hip fractures, disability, functional impairment and even death.[4] About one third of elderly suffer at least one fall each year and the incidence increases with age. [4] In addition, falls have an impact on a psychological and social level causing fear of falling, loss of confidence and restriction of social activities and quality of life.[4] Therefore, the understanding of the morphophysiological changes suffered by the elderly due to aging are of relevance for the planning of prevention programs and promotion of integral health in this population.

Musculoskeletal changes

Muscle mass decreases on average 0.4-0.8 kg per decade after 20 years, this loss being greater in men (1%) than in women (0.5%).[5] There is also a decrease of approximately 40% in the cross-sectional area between the ages of 20 and 80 years. [6] At the same time, the number and size of muscle fibers decrease significantly after 25 years of age.[7] Studies in the soleus muscle of aged rats and in the rectus femoris and brachial biceps muscles of elderly showed a decrease in the proportion and size of type II fibers, more specifically in type IIb.[7,8] Functionally, type II fibers are classified as fast contraction fibers, adapted to perform anaerobic metabolism and with high fatigue resistance capacity, so that their reduction in muscles of older people could cause slower motor responses and less ability to perform activities functional long-term, leading to a fall. [9]

Loss of muscle mass associated with aging is called sarcopenia.[10] Authors point out that sarcopenia has a multifactorial etiology and may result as a result of the normal aging process or associated pathologies.[11] Likewise, sarcopenia is related to an increase in the risk of suffering disability, slowing down, impaired balance and a greater number of fall.[12–14] Product of sarcopenia and age is evidence of loss of strength and muscle power, term known as dynapenia.[15] The new terminology is gaining support for use in clinical environments and research settings ; however, despite it's growing popularity, there remains some resistance because such new terminology might confuse efforts for building a consensus decision algorithm for sarcopenia.[16]

The reduction of muscle tissue is accompanied by an increase and infiltration of non-contractile structures such as fat and connective tissue.[17] Currently it has been proposed that adiposity and accumulation of fatty tissue could alter the normal mechanisms of force development, due to physiological and neuromuscular changes.[18] At the same time, the infiltration of fat in the muscle tissue would cause poor motor behavior, altering muscle activation patterns, conditioning a higher risk of falls.[19]

Capillarization of skeletal muscle fibers decreases as age increases, which could result in a reduced supply of oxygen and nutrients to peripheral muscles, in addition to a lower oxidative capacity.[20] All of the above, translates into a muscular disadvantage to take advantage of the oxygen supplied, leading to anticipated fatigue and, therefore, to less voluntary muscle control.

Regarding connective tissue, aging has shown changes in its structure, preferably associated with degenerative factors. It has been observed that tendons of elderly subjects have a higher stiffness, and with this, lower elastic capacity, mainly due to a decrease in the amount of collagen, which translates into modifications of the biomechanical function of the joints, limiting the mobility.[21,22] Studies performed on the calcaneal tendon suggest that with aging, its deformation capacity is reduced, which may cause changes in the ankle joint and in the pattern of walking, conditioning greater instability and falls.[23]

As for bone tissue, it undergoes changes in trabecular architecture and cortical porosity.[13] The osteones present in the bone cortex decrease with age, inducing fragility, osteoporosis, falls and fractures.[24] In the elderly, the most frequent fracture occurs in the coxofemoral joint, due to variations in the histological properties of the femoral neck such as cortical thinning and loss of spongy bone,[25,26] causing a high level of morbidity, mortality and disability.[25] It has also been reported that aging is accompanied by a decrease in osteoblastic modulation, which negatively influences bone mineral density and explains the high rates of fractures caused by falls in the elderly.[26]

Structurally, the bone system undergoes changes with age. This is reflected in changes in the spine, such as the occurrence of hypercifosis, which is defined an excesive anterior curvature in the thoracic spine. This curvature has been associated with function limitations, decreased balance, falls, fractures and decreased quality of life in elderly.[27]

Finally, with aging, a reduction in the number of mechanoreceptors of the sole has been reported, which is accompanied by a decrease in plantar sensitivity.[28] This decline is exacerbated by footwear, which impairs awareness of foot position through decreased tactile feedback, generating difficulty in maintaining standing position and increasing the risk of falls.[29]

Conclusion

Elderly have morphophysiological changes due to aging, which become factors that determine the risk of falls. These changes include the reduction in number and size of muscle fiber, loss of muscle strength, etc. The combination of these alterations translates into a greater vulnerability of the elderly in the face of disturbances in both static and dynamic activities. Therefore, it is recommended that fall prevention strategies incorporate activities that include multi-component stimulation in order to avoid functional impairment and even disability.

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Conflicts of interest

The authors of this manuscript have no competing interests.

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