Postural Stability: Effect of Age

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Abstract

The number of elderly persons is increasing in our society as a result of increase in life expectancy. Falls in elderly population is a major cause of morbidity and mortality. Falls in such persons can occur without any evident disease or postural difficulty. Postural instability has been documented in such persons. This may be a reflection of normal aging process. This instability becomes more obvious in conditions demanding higher degree of postural adjustments. In challenging conditions this instability may result in falls with varying degree of consequences. Proper preventive strategies can help in minimizing such fall and its consequences.

Introduction

The ability to maintain balance in an erect posture over a relatively narrow base is a unique feature of humans. This feature plays an important role in our day to day activities. Therefore abnormality in postural stability may lead to serious consequences adversely affecting the normal life. The functionally important components of balance are maintenance of posture, postural adjustments in anticipation of and during a self initiated movement and adjustments in response to an external perturbation. Balance emerges from a complex interaction between sensory and musculoskeletal systems, integrated and modified within the central nervous system in response to changing internal and external conditions. The sensory systems involved in the maintenance of balance include vestibular, proprioceptive and visual systems. The information provided by these sensory system are relayed to the central nervous system where they are analysed and processed into an appropriate response. The information from the central nervous system is carried down to the musculo-skeletal system to bring about movement of different body segments so that the centre of gravity remains within the stability range and thereby maintain erect posture. In addition to various disease conditions, aging can disturb the equilibrium of this close interaction of various systems to maintain balance adequately.

Age and Postural Stability

Postural instability is a common problem in elderly population. There may be numerous causes for age related postural disturbances. With increasing age there is increased probability of the elderly individuals for developing specific pathologies, which lead to accelerated degeneration in neural and/or musculoskeletal systems. Standing balance appears to be influenced by age. Progressive functionally evident, age related quantitative balance changes occur independent of typical geriatric pathological changes. A relatively inactive lifestyle may also result in disuse changes in neuromuscular system, including muscle weakness and slowed response time. A combination of reduced sensation, leg muscle weakness and increased reaction time appear important factors associated with postural instability in elderly. This instability in posture may result in falls. Age related...
deterioration in sensory motor function of muscles may contribute to the increased fear and frequency of falls in elderly subjects, thereby decreasing independence. Extensive research has been conducted on age-related changes in postural stability and balance. Alteration of stereopsis have close association with balance functions such as visual acuity, visual perceptual errors of verticality and horizontality, contrast sensitivity and stereopsis have close association with balance performance in elderly. Alteration of proprioception results in difficulty in balance in elderly persons. Thus in challenging conditions maintenance of balance becomes more difficult in such persons.

Postural sway increases with age. This becomes more evident with alteration to visual and peripheral sensation and especially when both are altered concurrently. In addition elderly persons are slower at detecting postural disturbances, which results in increased reaction time. Moreover the frequency and pattern of compensatory stepping reaction in response to unpredictable perturbation is different in healthy and active elderly persons from that in adults.

Muscle strength is also an important factor in balance performance. Weakness in leg muscle has been found to be associated with postural instability in elderly. In elderly persons weaker muscles impose a relatively higher demand during muscular activity leading to early fatigue and postural imbalance. The muscle strength in the hip, knee and ankle joints is closely associated with loss of balance during challenging balance tests in older persons. Weakness in the muscles around the ankle joint resulting in inability to generate necessary movement to maintain balance may be a cause of dominance of hip sway strategy in elderly persons. The relationship between muscle strength and balance might be in part due to a direct relationship between muscle power and balances and might be in part due to physical activity which can both maintain muscle power and stimulate balance responses.

After steady period in mid-adulthood the muscle strength start declining at around 50th decade of life. The maximum speed of movement also follows the same pattern of change with age. Furthermore type II muscle fibre shows significant atrophy with increasing age. The proximal muscles of the lower limb have been reported to be especially affected by muscle fibre atrophy and decline in maximum strength during aging.

Quadriceps strength is one of the most important factor for dynamic stability during gait and elderly persons with greater quadriceps strength shows shorter double limb support time than weaker individuals indicating a better balance in persons with strong quadriceps.

Effect of aging can also be seen in peripheral and central nerve conduction. The changes that are found with aging are slowed peripheral nerve conduction velocity, increased F-wave onset latencies in limbs, increased somatosensory evoked potential latencies and decreased spinal sensory conduction velocity. This decreased nervous conductivity may be a cause of increased reaction time in elderly persons.

The alertness, a precursor to attention, among older adults is a significant predictor of postural control when
vision is intact. Balance performance declines more in elderly subjects if engaged with additional cognitive demands. Even during quiet stance simultaneous performance of a cognitive task results in an increased postural sway which is more pronounced in elderly. As the sensory information decreases, the postural task becomes increasingly difficult for older subjects and requires more of their attention capacity. The ability to maintain a stable posture following an external perturbation is more attentionally demanding for older adults than for younger adults suggesting an increased risk for loss of balance and falls in some older adults if sufficient attentional resources is not allocated to the task of postural recovery. Therefore postural stability in older adults may be improved and falls reduced, through interventions, which enhance the alertness and attention among older subjects.

**Our experience**

We conducted a study to see the changes in balance performance with increasing age. The elderly persons enrolled in our study were healthy, without any obvious postural instability and without history of fall. We found an increase in postural sway which became more evident in conditions of conflicting sensory input. They were using predominantly hip sway strategy for maintenance of balance. Although the control of direction was maintained their velocity of movement was reduced and the reaction time was increased.

Overall balance performance started declining after 5th decade of life indicating deterioration of postural stability with age.

**Conclusions**

Old age is an important and integral part of one's life. It should be as enjoyable as previous days of life. Prevention of bodily damage is one of the important measures to achieve this goal. Fall, a major cause of such damage can occur without any evident balance problem. In such persons impairment of balance may be revealed by proper balance assessment. Many authors suggested this as a part of normal aging process. Although, it may not manifest during day to day activities, this instability may have adverse consequences in certain conditions which demand high degree of postural adjustments.

Therefore education/advice of elderly population regarding sensory consciousness, alertness, regular physical activity and provision of proper environment should be implemented which may be of great value in decreasing at least to some extent the falls and its consequences in elderly population.

**References**


