

Review Article

Hip Fractures in a Geriatric Population - Rehabilitation Based on Patients Needs

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ABSTRACT: With an increased life expectancy in humans and thus an increase in the number of the elderly population, the frequency of hip fractures will rise as well. Aside from a higher incidence, hip fractures in a geriatric population is a significant problem due to the possible onset of severe and in some cases dramatic complications and consequences. The primary purpose of treatment and rehabilitation in the elderly after a hip fracture is to improve an individual's quality of life. It is important to underline that principles and methods of functional restoration after hip fracture should consider careful planning of a rehabilitation program individually for every patient and its implementation with respect to decisions made by the rehabilitation team.

Key words: Hip fractures, Elderly, Rehabilitation

Hip fractures in the population above 65 years of age over the second half of the 20th century and at the beginning of the 21st century are becoming emerging problems for health care systems worldwide. These types of fractures are so far the most frequent cause of hospitalization after a fall in the elderly population and treatment is highly expensive [1]. With an increased life expectancy in humans and thus an increase in the number of the elderly population, the frequency of hip fractures will rise as well [2]. Although the findings of several studies indicate that the trend of continuous increase of fracture incidence is slowing down in the USA and in other several highly developed countries, the global incidence of hip fractures is still rising [3].

The incidence of hip fractures in females above 65 years of age in the USA rose from 964.2/100000 in 1986 to 1050.9/100000 in 1995, representing a 9% increase, while it declined up to 25.5% until 2005 to the level of incidence of 793.5/100000. Over the same period of time, the hip fracture incidence in the male population above 65 years of age rose from 392.4/100000 in 1986 to

456.6/100000 in 1995, representing a 16.4% increase, followed by a decline of 19.2% until 2005 to a level of incidence of 369.0/100000 [4,5].

Aside from the higher incidence, hip fractures in the geriatric population are a significant problem due to the possible onset of severe and in some cases dramatic complications and consequences. These types of fractures are responsible for increased mortality, up to 33% in the first year after the fracture [6,7]. It is important to underline that mortality in the elderly above 65 years of age is three times higher for those with hip fractures during the first year from the time of fracture, than for those without hip fractures [8]. In males above 80 years of age, after a hip fracture, life expectancy is decreased up to 58% and for females of the same age up to 38% [9]. From the population which survives the first year after a hip fracture, between 25% and 75% of them will never achieve the level of independence in physical activities as they had before the fracture [10]. The hip fractures permanently and significantly influence the quality of life in the elderly population. It is estimated that only half of

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those who were totally independent in their daily activities before a hip fracture, becomes rehabilitated up to the level for walking without aids, and every fifth person should be permanently placed in a facility for elderly care [11].

Medical procedures and principles that are implemented in health care system in order to reduce mortality rates for the elderly after a hip fracture may not coincide with rehabilitation methods that are used in order to achieve better functionally habilitated patients [12].

It is advised that during the follow-up period of functional recovery and estimation of quality of life, it is highly beneficial to identify key factors of functional recovery and estimation of effective rehabilitation models in geriatric population after a hip fracture [3]. Prior to initiating the rehabilitation program, it is suggested to evaluate effectively the patient's expected and realistic possibilities for recovery and functional limitations. These parameters will help us create the most appropriate rehabilitation mode and most acceptable rehabilitation program which will ultimately enable maximum possible functional recovery.

The primary purpose of treatment and rehabilitation in the elderly after a hip fracture is to improve an individual's quality of life. Therefore, it should be kept in mind that a complete check-up of patients with the introduction of achievable aims that will be reached through an adequate rehabilitation program and thus enable maximally independent life of the elderly after a hip fracture are the main tasks of rehabilitation team [13,14].

Specifics of geriatric population

Over the last 100 years with improvements in overall life standards and quality of health care, the chronological boundary in terms of being older constantly increases [3]. However, for follow-up of health condition and modes of treatment, the geriatric population is considered to encompass people over 65 years of age [3]. Individual variations in the geriatric population are far more expressed than in any other age category. Two elderly persons of the same age could be different in terms of health status, mental, social, physical and numerous functional aspects.

Although during the aging process similar changes are happening, these changes do not necessarily have the same speed and consequences as well as extent of influence.

Every organ and system is affected with morphological changes that are followed by physiological modifications. These processes in aged organisms lead to the decrease of overall functional and adaptive capacities. In order to illustrate this we present a partial list of commonly occurring problems in elderly. As an example,

the morphological changes of the nervous system, including both central and peripheral components, leads to cortical atrophy [15], loss of nervous cells and myelin which causes an increased time of reaction, improper memory and decline of receptor sensitivity. The musculoskeletal system is affected by osteoarthritis and osteoporosis with a reduction of muscle cells leading to decreased body height, improper posture, reduction in a joints range of movement and decreased muscle strength [16,17]. The geriatric population has different degrees of myocardial hypertrophy, coronary atherosclerosis and increased vascular stiffness leading to a decline of cardiac function, reduction of blood flow in affected vessels and increased peripheral resistance and blood pressure [18,19]. Often, various types and degrees of chest wall deformities are present with reduced compliance and respiratory surface, causing a decrease of maximal respiratory capacity. With aging, there are changes concerning nutritional habits, leading to alterations of the gastrointestinal system, leading to improper digestion [20]. The geriatric population has decreased renal function as well [21,22]. A decline in the endocrine function of the pineal gland and sex hormones leads to their diminished protective effects and changes the individual's adaptive capabilities [23-25]. The skin as an organ is also affected by aging, with a reduction in elasticity and decreased vascularization. Thus, decubital wounds are more frequently expected to develop. Bearing in mind the aforementioned changes that are connected with aging particularly in the elderly, a program of physical activity and rehabilitation should be individually planned with respect to overall patient's health condition and functional capacity.

With modified cognition in geriatric individuals it can be expected that short-term memory will be impaired, leading eventually to the slowing down of rehabilitation skill acquisition. Therefore, the rehabilitation program should be designed with practical skills known to the patient from an early period instead of insisting on new skills adoption [26]. In the elderly, depression and/or anxiety are common, thus pointing out the necessity for psychological evaluation and, in some cases, introduction of antidepressives [27].

Considering all the above facts, it may be extremely useful to develop adequate estimates of needs and capabilities of older people. Consequently, it is rather important to perform multidimensional functional estimation that is based on a tight coherence between medical diagnostic principles, functional estimation and psycho-social factors. The main goals of this type of patient parameter estimation are defining the choice of therapy and adequate continuous rehabilitation protocols implementation designed individually for every patient.

Comorbidity and its role on clinical presentation and treatment outcome

It is important to stress that geriatric patients have numerous chronic conditions with their consequences and therapeutic dilemmas. Chronic diseases in the elderly often cause result in various degrees of interactions, leading to the frequent onset of complications and thus a more severe course of treatment [13]. Therefore, chronic diseases and/or conditions along with hip fractures imply that the clinical presentation during the follow-up of these patients is often somewhat complex.

Previous studies evaluated the influence of certain comorbidity aspects on clinical presentation, treatment outcome and rehabilitation of the elderly after a hip fracture [28-34]. It was noticed that there is significant correlation between comorbidity and falls that would lead to hip fractures, and thus greater incidence of hip fractures in patients with diabetes, eye cataracts and hypertension [33,34]. In these patients, surgical interventions are usually postponed, leading to the increased onset of potential complications (cardiovascular, musculoskeletal, neurological, cognitive, etc) [32-34], and hence more complicated and complex rehabilitation programs [35,36].

Due to the large number of co-joined conditions and/or diseases that are often present in the elderly population, as well as objective and uniform evaluation, comorbidity indices are more frequently used in scientific work instead of following up certain disease or condition courses [37]. Further indices are often used: Charlson Comorbidity Index (CCI), Chronic disease score (CDI), Index of Co-Existing Disease (ICED), Kaplan-Feinstein Classification (KFC) and Cumulative Illness Rating Scale for Geriatrics (CIRS-G) that is specifically designed for the geriatric population [28,29,38]. The CIRS-G estimates 14 independent categories concerning the health condition state by scoring them from 0 to 4, where 0 represents state without illness while 4 state with extremely heavy condition. The total comorbidity score is estimated by calculation of these independent categories, as well as the number of categories with grade 3 and grade 4. It is also possible to calculate the Severity index (SI) [6].

In the work of Radosavljevic et al., [3] it was noticed that the most frequent comorbidity referred to the vascular system, followed by heart conditions and musculoskeletal problems. Similar findings concerning hypertension and heart disease in the geriatric population with hip fractures were reported as well [35,36,39], while data regarding musculoskeletal comorbidity was less frequently analyzed. One of the possible explanations justifying this observation referred to the assumption that the majority of studies which evaluated comorbidity actually followed

the mortality of patients, while a smaller number of performed studies investigated the functional recovery for which the musculoskeletal system condition is of great importance. These facts regarding the presence and complexity of comorbidity factors significantly influence the design and implementation of the rehabilitation program as well as treatment length and ultimately rehabilitation outcome [33,40-44].

Rehabilitation model after hip fracture in elderly

Rehabilitation of patients after hip fractures presents different procedures that are aimed to achieve and maintain maximal functional capacity and quality of life. Therefore, it can be stressed out that the main goal of rehabilitation treatment is to achieve an optimal functional state with maximal independence in performing functional tasks.

It is important to underline that principles and methods of functional restoration after a hip fracture should consider careful planning of the rehabilitation program for every individual patient and its implementation with respect to decisions made by the rehabilitation team. The rehabilitation team should consist of a board certified and licensed physiatrist, physical therapist, occupational therapist and in some cases psychologist and social worker. Such a professional team coordinates its treatment with the surgeon and medical doctors of other specialties, including: cardiology; neurology; endocrinology; etc. Most frequently the success of the treatment is closely associated with the good cooperation between the rehabilitation team and the relatives of the patient [45].

With respect to other types of fractures, patients with hip fractures should be evaluated sensitively and carefully. Premature and intensive mobilization could result in secondary dislocations, untimely (late) and improper implementation of the rehabilitation program will not provide optimal functional restoration to the patient. Therefore, prompt and on time early mobilization is a major precondition of treatment success [3].

The rehabilitation program should consider: the type of fracture; localization of other injuries and mode of fixation. Further, other factors are important as well: patient's age; overall patient's condition; previous diseases and injuries; and conditional capacity [46].

The main goals of physical therapy and rehabilitation are: reducing the severity and onset of pain; preventing muscle atrophy; cardiopulmonary and vascular complications; psychological changes; and depression. The rehabilitation program should also aim to improve the maximal motion of range in the hip joint, muscle strength in the affected extremity and to restore movement coordination [3].

An early rehabilitation program is preferred to begin with breathing exercises for the prevention of pulmonary complications and active isotonic exercises particularly plantar and dorsal foot flexion with elevated leg for vascular complications (thrombosis) prevention. Initial isometric and passive exercises during the rehabilitation program are replaced with active exercise and gradual verticalization. Active exercises are performed by a gradual introduction of increasing resistance for the purpose of muscle strengthening [3,46-48].

Kinesiotherapy as part of the rehabilitation program in patients who have suffered hip fractures consists of a group of exercises that are designed according to the patient's needs, functional state and surgical treatment mode [3]. Such a rehabilitation mode is aimed to improve the range of motion in hip and knee joints, muscle strengthening, coordination and balance restoration, and quality of patient life.

Occupational therapy presents significant component in the rehabilitation of patients with hip fracture, particularly in an older population, since it enables them to proceed with maximal functioning in everyday activities after discharge from rehabilitation treatment [49].

The role of mathematical modeling in hip fracture treatment and prevention

Medical research has a rather complex relationship with formal mathematical modeling. The main difficulty lies in the fact that most medical phenomena are governed by rather complex relationships and/or causalities. Regardless of this, the mathematical models are important from at least two standpoints:

a) From the clinical standpoint, they enable clinicians to improve prediction, prevention, and diagnosis as well as treatment procedures,

b) From the academic standpoint, mathematical models are extremely useful, as they can provide valuable insight into understanding the underlying physiological processes.

Currently most of the research related to mathematical models in hip fractures can be classified into following two areas:

a) Statistical models that attempt to investigate various interdependencies in order to determine incident predictors and risk factors,

b) Mathematical models that attempt to predict recovery and/or cost.

In the first area, mathematical models have been extensively used for the analysis of risk factors in the various groups of interest [50-52]. In the work of Cummings et Nevitt, the authors proposed a mathematical model based on four conditions to explain the exponential

rise in hip fracture incidences with aging [50]. In the work of Cumming et al., the authors assessed model based risk factors in 9516 white women 65 years or older without previous hip fractures [51]. In the work of Kanis et al., the authors constructed four different models in order to evaluate probabilities of hip fractures of men and women aged 50 years or more in the UK [52]. In the work of Morrison et al., the authors investigated the relationship between pain, analgesics, and other factors following hip fractures [53]. In the work of Hans et al., the authors demonstrated that ultrasonographic measurements can be used as hip fractures risk predictors [54]. Although the above list is partial, it illustrates that statistical mathematical models are often used efficiently to examine various interdependencies in order to determine occurrence predictors.

In addition to this approach, the development of mathematical models that can be utilized in the prediction of outcomes has also been subject of considerable research interest. Previous studies demonstrated that the Berg balance scale and Functional independence measure can be used for prediction of the recovery [55-57]. In the work of Boonen et al., the authors documented functional outcomes and quality of life following a hip fracture in elderly women [58]. In the work of Braithwaite et al., the authors developed a Markov model for predicting lifetime mortality, morbidity and cost of hip fractures in the elderly population [59].

In conclusion, all of these research projects demonstrated that mathematical models can be a powerful tool for effective clinical management of both therapy and recovery. However, an effort should be made to establish the most efficient way in which results similar to the aforementioned can be incorporated into everyday clinical practice.

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