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Mechanisms and Causes of Osteoporotic Hip Fractures in Elderly Patients

Yaşlı Hastalarda Osteoporotik Kalça Kırığı Nedenleri ve Oluş Mekanizması

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Abstract

Objective: To investigate the causes and occurrence mechanisms of osteoporotic hip fractures in elderly patients in Turkish society.
Materials and Methods: This study included 83 consecutive patients who were operated in our clinic due to hip fractures in 2013-2014. The demographic characteristics of the patients, causes and types of fracture, occurrence mechanisms, and location of the fracture, as well as whether the patients lived alone and whether they used walking support were recorded. This information was evaluated retrospectively and analyzed by comparison according to the sex.
Results: Ninety-four percent of the patients fell on their right or left side hip joint, and 74% of them fell due to balance disturbances, without any contributing environmental factors. Eighty percent of the patients were injured at home and 56% of them used walking assistance. Only 18% of the patients lived at home alone. According to the Body Mass index only 3% of the patients were obese or overweight, while 49% were underweight.
Conclusion: Most patients with hip fracture over the age of 75 are low weight and living with caregivers. Most fractures occur via balance disturbances without any environmental factors and the majority of the patients' fall on one side, not to the front or back. Modifying the patient's clothes and floor materials to reduce the severity of trauma during fall can help reduce the incidence of hip fractures.
Keywords: Hip, fracture, cause, mechanism, elderly patients, osteoporosis

Öz

Amaç: Türk toplumunda yaşlı hastalarda osteoporotik kalça kırık nedenlerini ve oluş mekanizmasını araştırmak.
Gereç ve Yöntem: 2013-2014 yıllarında kalça kırığı nedeniyle kliniğimizde ameliyat edilen 83 ardışık hasta çalışmaya dahil edildi. Hastaların demografik özellikleri, kırık oluş nedenleri ve kırık tipleri, oluş mekanizması, kırığın olduğu yer, hastaların yalnız yaşayıp yaşamadığı ve yürümek için destek kullanıp kullanmadığı kaydedildi. Bu bilgiler retrospektif olarak değerlendirildi ve cinsiyete göre karşılaştırılarak analiz edildi.
Bulgular: Hastaların %94'ü sağ veya sola doğru kalça eklemi üzerine ve %74'ü herhangi bir çevresel faktöre bağlı olmaksızın dengelerini kaybederek düşmüştür. Düşmelerin %80'i ev içinde olmaktadır ve hastaların %56'sı yürümeye yardımcı destek kullanmaktadır. Hastaların sadece %18'i evde yalnız yaşamaktadır. Vücut Kitle indeksi değerlerine göre hastaların sadece %3'ü obez veya aşırı kilolu iken %49'u düşük kiloludur.
Sonuç: Yetmiş beş yaş üstü kalça kırığı olan hastaların çoğu düşük kilolu ve bakım için yardım alan kişilerdir. Kırıkların çoğu herhangi bir çevresel faktöre bağlı olmaksızın denge kaybı nedeniyle oluşmaktadır ve hastaların çoğu öne ya da arkaya değil yan tarafa doğru düşmektedir. Hasta kıyafetlerinin ve zeminin düşme esnasında oluşan travma şiddetini azaltacak şekilde modifiye edilmesi kalça kırığı insidansını azaltmaya yardımcı olabilir.
Anahtar kelimeler: Kalça, kırık, neden, mekanizma, yaşlı hastalar, osteoporoz

Introduction

With life expectancies increasing, the annual worldwide incidence of hip fractures is estimated to increase to more than 6 million by mid-century (1). Excessive alcohol consumption, physical inactivity, visual impairment, aging, female gender and especially osteoporosis are all risk factors for hip fractures (2,3). Globally, it is estimated that approximately one in three women and one in eight men over the age of 50 years old are at risk of osteoporotic fractures during their lifetimes (4). Although osteoporosis is the most important factor in hip fractures, it is not sufficient to produce them in and of itself. A fall from a standing height is the main mechanism of injury for fractures in elderly people, although several other factors can contribute,

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including falls from elevated heights and traffic accidents (5).

An osteoporotic hip fracture is an important cause of morbidity and mortality in the older population. One-half of previously independent individuals become partly or totally dependent, with 5-20% dying within 1 year following such an injury (6). Moreover, the economic cost of these injuries is a significant issue. It is obvious that the incidence of osteoporotic hip fractures is an important healthcare problem which should be addressed.

The mechanism, incidence and pattern of fracture differ between populations due to climatological, sociological and demographic properties, and they also depend on environmental factors, the level of development, and the regulations of different populations (7). Therefore, different planning strategies and lifestyle recommendations, according to the population, are needed to prevent or decrease the incidence of osteoporotic hip fractures. There are several studies about the various mechanisms of hip fractures in the literature, but none that investigated a Turkish population. Thus, the aim of this study was to analyse the injury mechanisms and fracture patterns in individuals over 75 years old with proximal femur fractures in a Turkish population.

Materials and Methods

After obtaining institutional ethics committee review board approval, 83 consecutive patients (over 75 years old) who were operated on from 2013 to 2014 with the diagnosis of hip fractures were included in this study. Written informed consent, approved by our institutional review board, was obtained from all patient. Femoral neck, intertrochanteric and subtrochanteric fractures (up to 5 cm away from the trochanter minor) were accepted as hip fractures. Each of these patients filled out a questionnaire before undergoing surgery. The patients' demographics, causes and types of fractures, mechanisms, places and whether the patients lived alone and whether they used walking support were recorded, and their records were evaluated retrospectively and compared according to the sex. Those patients who had pathological fractures, a previous hip surgery, an inability to walk before the injury, and mental incompetence to answer the questions on the form were excluded from this research.

Statistical Analysis

All data were analysed using SPSS Statistics for Windows, version 20.0 (IBM Corp., Armonk, NY, USA). The Mann-Whitney U test was used to compare the descriptive statistical measurements. Pearson's chi-square and Fisher's exact test were used to determine the differences between categorical variables. Statistical significance was determined as $p<0.05$.

Results

A total of 83 patients were included in this study; 25 (29%) males and 58 (71%) females with a mean age of 83±5 years old. Twenty-four (28%) were femoral neck, 53 (63%) were intertrochanteric, and 6 (7%) were subtrochanteric fractures. Only 15 (18%) of the patients lived at home alone (Table 1). According to the body mass index values, 49% of the patients were underweight, with only 3% being overweight or obese. Most of the women patients used walking assistance and had IT fracture and it was statistically significant when compared according to the men (Table 2).

Discussion

The results of the present study revealed that over the age of 75 most patients with osteoporotic hip fractures are thin, with low body weight, and live with at least one other person. The fractures occurred most often at home via balance disturbances, without any associated environmental factors, and the majority of the patients fell on one side.

Body weight is an important factor in the occurrence of an osteoporotic hip fracture after falling down. Mussolino et

Table 1. Patient demographics and variables related to the hip fracture

	n	%
Sex		
Man	25	30.1
Woman	58	69.9
Age (year)	Mean ± SD: 83±5, Median: 83 minimum: 75, maximum: 96	
Reason for falling		
Balance disturbance	62	74.7
Environmental factors	21	25.3
Direction of falling		
Lateral	78	94.0
Posterior	3	3.6
Anterior	2	2.4
Type of fracture		
IT	53	63.9
CF	24	28.9
ST	6	7.2
Walking assistance		
No	36	43.4
Yes	47	56.6
Where the patient fell		
At home	67	80.7
Outside	16	19.3
Living alone		
Yes	15	18.1
No	68	81.9

n: Number, IT: Intertrochanteric, CF: Collum femoris, ST: Subtrochanteric, SD: Standard deviation

Table 2. Comparison of variables according to the sex

	Man		Woman			
	n	%	n	%	χ^{2**}	p**
Reason for falling						
Balance disturbance	17	68.0	45	77.6	0.8	0.36
Environmental factors	8	32.0	13	22.4		
Type of fracture						
CF	11	47.8	13	24.1	4.2	**0.04**
IT	12	52.2	41	75.9		
ST*	-	-	-	-	-	-
Walking assistance						
No	15	60.0	21	36.2	4.0	**0.045**
Yes	10	40.0	37	63.8		
Where the patient fell						
At home	18	72.0	49	84.5	1.7	0.23[f]
Outside	7	28.0	9	15.5		
Living alone						
Yes	20	80.0	48	82.8	0.1	0.76[f]
No	5	20.0	10	17.2		

n: Number, IT: Intertrochanteric, CF: Collum femoris, ST: Subtrochanteric
*: Could not be analyzed because the number is insufficient
**: Pearson's chi-square test , [f]Fisher's exact test

al. (8) found that a low body mass was associated with a higher risk of hip fracture. In addition, Farahmand et al. (9) and Langlois et al.(10) reported that a weight loss of 10% or more is associated with an increased risk of hip fracture. Ensrud et al. (11) explained this phenomenon by the fact that patients with smaller body sizes have lower bone mineral densities. Conversely, Maffulli et al. (12) reported that patients with trochanteric fractures tended to be overweight. They explained this via the formation of the trochanteric region from predominantly cancellous bone, which is metabolically more active than cortical bone. Moreover, overweight patients can have nutrient deficiencies affecting bone metabolism, such as calcium, vitamin K or vitamin C. In our study, 49% of the patients were underweight, while only 3% were overweight or obese. We believe that in addition to lacking the protective effect of adipose tissue, underweight patients suffer from malnutrition more often and have more comorbidities which may make them prone to falling.

Often, environmental factors can lead to falls causing hip fractures. Although King and Tinetti (13) reported that environmental factors may be important in cases of falls and fractures, Norton et al. (14) suggested the reverse. They reported that 85% of the falls resulting in hip fractures occurred at home, with 15% occurring outside, and only about 25% of the home falls were associated with environmental hazards. Allander et al. (15) also suggested that environmental hazards were of minimal importance in mediating hip fractures. In our study, 82% of the patients were at home during their injuries, and 75% of the patients fell down due to balance disturbances, without any associated environmental factors. These results can be explained by the fact that those patients who could travel away from home were probably healthier than those who could not. Thus, it can be extrapolated that those patients who are older and in poor health tend to fall down without any environmental factors as a result of the inability to move about independently at home.

As people become older, their physical capacities decline. Moreover, the presence of cognitive impairment, such as depression, Alzheimer's disease and dementia, and disturbances in the mechanisms of balance predispose the elderly to falls, resulting in a higher incidence of hip fractures (16,17). Impairments in perception, vestibular functions, proprioception and circulatory functions are seen most often in the elderly and can be related to balance disturbances (18,19). The loss of vibration sense, reduced pain perception and absent Achilles and quadriceps reflexes also increase the hip fracture risk during falls (20). Therefore, an individual's general health status is one of the most important factors in determining whether a person will fracture their hip or not. In this study, we did not evaluate the patient-dependent physiological factors individually, but we did find that only 17% of the patients lived at home alone, with 83% of the patients living with at least one family member. Moreover, most of the patients used walking assistance. We concluded that those elderly patients who are not able to live alone and walk without support have a higher fracture risk.

Nankaku et al. (21) evaluated the hip fracture risk in relation to fall direction. Eight healthy volunteers performed deliberate falls in lateral, posterolateral and posterior directions on a platform. The fall descent motions and impact postures were then examined using a three-dimensional analyser. The ground force reaction, velocity at impact and activity of the quadriceps and gluteus medius muscles were measured. They reported that a fall in the posterolateral direction carried a higher risk of hip fracture. Hwang et al. (22) reported that elderly women who fell sideways were 12.8-fold more likely to have a hip fracture than those who fell forward. In accordance with the literature, the majority of the patients (94%) in our study fell to one side on their hips; therefore, we believe that, if it is possible, changing the direction of the fall by using walking assistant may be effective in decreasing the hip fracture rate.

When compared according to the sex there are significant differences between different populations. In eastern countries incidence rate of hip fracture similar between both sex or may be higher in men (23,24). Yan L et al. (25) reported that the age-adjusted incidence rate of hip fracture was 67/100,000 in women and 81/100,000 in men in a chinese population. In contrast, the incidence rate of hip fracture was significantly higer in women (25-29). In this study, incidence rate of hip fracture was also higher in women ($p<0.05$). In addition,

when compared according to the sex, number of the patients using walking support was significantly higher in woman (Table 2).

Our study has several limitations such as relatively low number of patients and lack of dual-energy X-ray absorptiometry results of the patients which is an essential factor related to osteoporotic hip fracture.

Conclusion

Those patients with poor health statuses are more prone to osteoporotic hip fractures. Environmental changes, such as eliminating floor coverings and internal steps, and using shower and toilet railings, may seem to be useful but environmental factors have minimal effects on osteoporotic hip fractures, so these practices will not be beneficial. Changing the direction of the fall, educating the patient's accompanying relatives, and modifying the patient's clothes and floor materials to reduce the impact energy during a fall may help to reduce the incidence of osteoporotic hip fractures.

Ethics

Ethics Committee Approval: The study were approved by the Local Ethics Committee of Medicalpark Hospital (Protocol number: 2019-2-3).

Informed Consent: Consent form was filled out by all participants.

Peer-review: Internally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: A.U., Concept: A.U., Design: A.U., Data Collection or Processing: A.U., Analysis or Interpretation: S.D., Literature Search: S.D., Writing: S.D.

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