

Hip Fractures Risk and Postoperative Period in Elderly Diabetic Patients

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Abstract

Hip fractures with the numbers about 1.6 million over the world in 2000 are serious health problem which drastically limits the functionality and increases mortality in geriatric population. Peritrochanteric and neck hip fractures result from the reduction of mineral bone density or impaired quality, however age related co-morbidities add additional risk related to increased incidence of falls. The one of the diseases found to increase hip fractures incidence and associated mortality is diabetes which currently affects 415 million adults over the world with increasing prevalence, predicted to 642 million by 2040. Type 1 diabetes contributes to fragility by unfavorable changes in bone metabolism. Although type 2 diabetes effects on bone may be paradoxically opposed, it still increases risk of falls and hip fractures. The causes of increased fractures risk via precedent falls comprise of diabetic angio and neuropathic complications affecting central nervous system, vision, balance and also results from polypharmacy. Diabetes influences also the postoperative period, deteriorating wounds healing and promoting sores formation. The scope of diabetes impact on hip fractures risk and orthopaedic surgery results should be particularly considered together with proper glycemic control to prevent postoperative complications and improve patient prognosis.

Keywords: Hip fracture risk; Diabetes complications; Sarcopenia; Hypoglycaemic

Introduction

In the light of demographic changes the participation of elderly people in populations of Europe countries, as well as in United States of America increases, which although adds a huge value to societies, is an unusual and difficult challenge for national healthcare systems. It is estimated that American population aged 65 and above will increase from 14.5 % (46.2 million) in the year 2014 to 21.7 % of the population by 2040, and by the 2060 there will be 98 older persons, more than twice their number in 2014 [1]. In the European Union countries (the Eurostat database), consistently with reduced births rates and higher life expectancy, there is forecast for an increasing share of the aged 65 years or over in total population from 18.9% in 2015 (96 million) to 28.7% by 2080 (149 million) with adjustment for projected population size of 520 million (EUROPOP2013) [2]. The prolonged the individual life-time, connected with a better healthcare, also the longer time needed to the progression of time-dependent chronic diseases complications especially affecting functionality. Those include atherosclerosis with cardiovascular disease affecting heart and diminished physical efficiency; involvement of central nervous system with brain lesions, stroke or neurodegeneration limiting mental or physical activity and leading to dementia; the narrowing of the arteries of lower extremities causing intermittent claudication with pain and mobility disturbances. Further, the cancers distinctive for older age, associates with malnutrition or cachexia. Those exacerbate sarcopenia which influence the physical level of activity exacerbating frailty [3]. The osteoporosis, rheumatoid chronic diseases and arthropathies revealing especially in elderly, impair mobility, decrease bone quality and together with other risk factors contribute to life-threatening fractures. The diabetes is a worldwide epidemics and an exceptional

chronic condition connected with many co-morbidities causing faster decline in functionality. It seems, however, that there is also an association between diabetes and sudden health problem such a bone fracture. The surprising correlation of diabetes and hip fractures risk in elderly emphasize particular precaution against falls in older patients with diabetes. It also urges to appropriate glycemic control in the term of peri- and postoperative regimen if fracture occurred and orthopaedic surgery has to be performed but complications are to be minimized.

Approximately 1.6 million hip fractures occur worldwide each year, by 2050 this number could reach between 4.5 million and 6.3 million [4]. For the year 2000, there were an estimated 9 million new osteoporotic fractures, of which 1.6 million were at the hip, 1.7 million were at the forearm and 1.4 million were clinical vertebral fractures [5]. The number of fractures increases with patient age. Hip fractures cause the most morbidity with reported mortality rates up to 20-24% in the first year after a hip fracture, and greater risk of dying may persist for at least 5 years afterwards. Loss of function and independence among survivors is profound, with 40% unable to walk independently, 60% requiring assistance a year later [6-8]. The data of new fractures total number in Poland are limited. In 2005, according to National Health Fund in Poland, 15 888 people over 50 years of age were operated with hip fractures [9]. Jaworski and Lorenc on the Mazovian population basis, estimated the number of these fractures at 27 434, which determines the incidence of 280 [10].

Diabetes mellitus (DM) is one of the most important causes of mortality and morbidity in older subjects. Currently 415 million adults have diabetes, by 2040 diabetic population will rise to 642 million [11]. In Poland the number patients with diabetes reaches almost 3 million people [11]. The main aim of diabetic patients treatment is the late complications prevention-diabetic neuropathy and angiopathy. The important goals of good control of diabetes are normoglycemia and

HbA1c value below 7%. The good metabolic control especially in elderly people is associated with a higher risk of hypoglycemia. According to the ADA 2016 recommendations in patients with type 2 diabetes good metabolic control means HbA1c < 6.5 % in short-term cases and 7% for others. The exception is the elderly (patients aged over 70 years) with longstanding diabetes > 20 years with co-occurring significant macrovascular complications. In this group, HbA1c level equal or below 8% is sufficient [12]. Piatkiewicz et al. proved that low HbA1c level indicates inappropriate intensification of the diabetes treatment and it is associated with higher risk of severe hypoglycaemic episodes in elderly. The most severe hypoglycaemic episodes have been reported in sulphonylurea or insulin-treated type 2 diabetic patients. One of the reasons for life-threatening hypoglycaemia is overtreatment of diabetes in old patients, proven by the invalid values of HbA1c obtained in this study, which are clearly lower than those recommended by the ADA and PTD. The authors noted that low glucose levels can also lead to falls resulting in fractures and traffic accidents [13].

As the result of long disease duration and associated complications, patients' medical care costs with this disease are approximately two times higher as compared to the healthy subjects [14].

In type 1 diabetes (T1DM) reduction of the bone mineral density (BMD) is a result of insulin deficiency. This occurrence partially explains the greater susceptibility to fractures in diabetic group of patients [15]. Also some observational studies on patients with type 2 diabetes (T2DM) with osteoporotic fractures indicated increased fractures incidence compared to patients without this disease, but results are inconsistent [16]. Interesting fact is that while a low BMD is consistently observed in people with T1DM, in T2DM bone mineral density is normal or higher than in non-diabetic patients [17]. Such paradox has no one explanation; it is complex and may be explained by many factors. Especially two of them: an increased rate of fall risk and lower bone quality seems to be important [18,19].

According to Burghardt et al. observation in patients with T2DM trabecular bone structure is intact or enhanced, whereas it is the cortical bone that is preferentially compromised [20,21]. Such observation is relevant and important as the cortical bone builds 80% of the skeleton and fractures in people with DM often occur in places rich in cortical bone [22].

One of the largest retrospective cohort studies compared risk of the hip fracture was made in an elderly Canadian population. It compared women and men with diabetes over a 6-year follow-up period [22]. The study showed that diabetes increased hip fracture risk by 18% in men and by 11% in women, after taking into account potential interfering factors, including co-morbidities, age and drugs that increased the risk of falls. [22]. New Swedish investigation from 2017 showed that in patients with insulin-treated T2DM, the risk of hip fracture was higher in men and women. T2DM-treated with the oral diabetic drugs was related to increased hip fracture only in women [23].

Janghorbani et al. published a meta-analysis of studies involving a total of more than 800 000 T1DM and T2DM patients, and reported a positive association between T2DM and any foot fracture, non-vertebral fracture, and hip fracture [24]. According to this analysis the association between diabetes and hip fracture also persisted after adjusting for age, body mass index, physical activity, and tended to be stronger in men than in women and in long-standing diabetes [24,25].

A total of 15 observational studies (11 cohort and 4 cross-sectional, 263 006 diabetics and 502 115 controls) diabetes was demonstrated to increase the risk of hip fractures by 29.6% ($P=0.008$) [16]. It also supports the association between T2DM and increasing of hip fracture risk in postmenopausal women.

Two huge cohort studies: the ABC Health Study and a Swedish population study reported higher fracture incidence in diabetic patients with peripheral neuropathy [26]. Also this study's results suggested that peripheral vascular diseases seem to be inversely correlated with BMD in the diabetic population [26,27].

Ivers et al. described in an older Australian population, that diabetic patients with complication like a retinopathy also presented a higher fractures risk (five times more) than that observed in patients without such complication [28]. Similarly, Schwartz et al. found that low physical activity, falls, and the use of benzodiazepines accounted for the association between diabetes and fractures [29].

According to Gulcelik et al. diabetic patients with hip fracture had a higher risk of mortality than the non-diabetic patients. They found that one year survival probabilities of non-diabetic and diabetic patients were respectively 87.3% and 68.0% ($p=0.033$) [30].

Due to an increased risk of mortality after hip fracture in diabetic patients the post-operative medical care especially glycemic control and postoperative complications prevention, should be optimized in order to decrease mortality in these groups of patients [17].

In summary, in type 1 diabetes reduction of the bone mass density (BMD) explains increased susceptibility to fractures. However, patients with type 2 diabetes generally have normal or even increased BMD. This apparent occurrence may be explained by the fact that, at a given level of BMD, diabetic patients present lower bone quality with respect to non-diabetics, as shown by several studies reporting that diabetes may affect bone tissue by means of various mechanisms, including hyperinsulinemia, deposition of advanced glycosylation endproducts in collagen, renal failure, reduced serum levels of GF-1, hypercalciuria, microangiopathy and inflammation [15,17-19,28-30].

Carpintero et al. observed that poor glycemic control is a common preoperative complication of diabetic patients with hip fracture surgery. Abnormal blood glucose level is additionally associated with an increased risk of perioperative infection and a life-threatening asymptomatic coronary artery disease [30]. It seems that especially malnutrition and diabetes are clearly related to deep, serious infections [31]. Treatment of wounds in all elderly patients results in worse outcomes. Diseases (multiple comorbidities, diabetes, dementia or cognitive impairment, cancer, cardiac disease) and eating disorders further aggravate this problem [32].

In 2017 Reatequiu et al. evaluated the reduction of postoperative complications in patients after orthopedic surgery with particularly, good controlled diabetes mellitus. After surgery and discharge from the hospital, the patients were transferred to PCP (Primary Care Provider), who was responsible for proper treatment and control of glycaemia. Patients who did not participate in PCP care had an independent predictor of medical complications of surgical infections and mechanical complications. The study confirmed that decrease HbA1c level is related to less medical complications [33].

One of the most important and serious causes of musculoskeletal system infections in the elderly is osteomyelitis. Elderly patients have an increased incidence of predisposing disorders to osteomyelitis (such as diabetes, atherosclerosis or caries). In addition, the number of

surgical procedures in the elderly population increases with aging (e.g., teeth removal, open heart surgery and orthopedic surgery) [34]. Surgical procedures, especially those relating to the skeletal system, are an additional risk factor for osteomyelitis. The most commonly occurs organisms associated with osteomyelitis in patients with diabetes mellitus are *S. aureus*, group B *streptococci*, aerobic gram-negative bacilli, and *B. fragilis* [345902078020001]. The osteomyelitis represents a significant risk of complications after hip fractures in elderly diabetic patients.

Conclusion

Diabetes is one of the most common illnesses in the elderly people. It not only causes numerous complications including most often described vascular and neurological but additionally increases the risk of fractures. The incidence of life-threatening hip fractures, which drastically deteriorate precedent functionality, is increasing with aging of population. The causes of fractures always remain complex, combining external factors such as an increased risk of falls in the geriatric population and also metabolic causes leading to change in bone mineral quality and increase in fragility. There are also some differences among bone mass density in type 1 and type 2 diabetes. Recent studies have also shown the effect of antidiabetic treatment on fractures frequency. Hip fracture risk associated with diabetes as civilization disease of increasing prevalence, and specificity of diabetic perioperative complications in orthopaedic surgery should be emphasized to undertake proper management enabling the most favorable recovery.

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