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ORIGINAL ARTICLE

Estimated Glomerular Filtration Rate and Low Energy Hip Fracture

Running Title: Glomerular Filtration Rate

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ABSTRACT

Introduction: Chronic kidney disease is commonly seen with reduced calcium and low-energy fractures. In this study, we investigated the relationship between estimated glomerular filtration rate and low-energy hip fractures. **Methods**: This cross-sectional study was performed on 418 patients with low energy hip fracture in Imam-Khomeini Hospital during 2019-2020. Correlation of estimated glomerular filtration rate with other variables was investigated. **Results**: Of the studied patients, 203 (48.6%) had estimated glomerular filtration rate below 60 and 215 (51.4%) had estimated glomerular filtration rate above 60. Female patients with estimated glomerular filtration rate below 60 were more common, underlying diseases of diabetes and hypertension were significantly higher in estimated glomerular filtration rate below 60, and mean age and creatinine levels in estimated glomerular filtration rate below 60 were significantly higher than eGFR above 60. The mean hemoglobin level in subjects with estimated glomerular filtration rate below 60 was significantly lower than those with estimated glomerular filtration rate above 60 ($p < 0.05$). Mortality was significantly higher in subjects with estimated glomerular filtration rate below 60 than in those with estimated glomerular filtration rate above 60. There was no significant relationship between estimated glomerular filtration rate and type of fracture and ischemia ($p > 0.05$). **Conclusion**: Management in the prevention of hip fracture and treatment of patients with renal failure can be effective in the treatment of fracture and reduce its mortality.

INTRODUCTION

Low energy fractures around the hip are associated with high morbidity and mortality. Two factors, such as low bone density and low energy, contribute to these fractures (1). Patients with reduced glomerular filtration rate (GFR) and chronic kidney disease develop bone disease. Changes in calcium and phosphate metabolism as well as altered circulating calcitriol levels and elevated parathyroid hormone (PTH) are effective in causing bone disease (2). In patients with end-stage renal failure, they develop osteoporosis with metabolic problems caused by uremia, called renal osteodystrophy (3). At a low level of GFR is associated with a risk of fractures around the hip (4). Dooley et al. In a cohort study concluded that grade 4 renal failure was strongly associated with a low energy hip fracture probability (5). In a prospective study, Yenchek et al. Looked at patients with grade 3 renal failure after bone mineral density (BMD) and concluded that grade 3 renal failure was associated with an increased rate of fracture around the hip (6). Seliger and colleagues found in a study that patients with renal failure were hospitalized for fractures around the hip and that their complications were higher (7). In a study in Kashmir, Najar et al. Showed that osteoporosis was higher in people with renal failure than in the control group (8). Nicolas et al. In their study also found that people with moderate to severe failure were more likely to be fractured (9). In another study conducted in 2014, the association between moderate to severe renal disease with hip fracture and even mortality was examined (10). There are also some post-operative results, such as the study of Mr. Kou, who examined the results of femoral neck fracture surgery in patients with renal failure, which showed a higher incidence of complications than those without renal failure (11).

Given the high incidence of fracture of the hip, we decided to examine its predisposing factors and find that, if associated with a reduced GFR, it would be possible to identify patients with early fractures of the kidney disease and to recognize the complications early and begin treatment sooner. Patients with chronic illness should receive all the necessary training to prevent hip fracture. In this study we aimed to investigate the relationship between low hip fracture patients admitted to Imam Khomieini hospital of Tehran with low

eGFR, and also to evaluate mortality and hospitalization in these patients compared to patients without failure.

MATERIALS AND MRTHODS:

This cross-sectional study was retrospectively performed on 418 low energy hip fracture patients in Imam-Khomeini hospital of Tehran during 2019-2020. Inclusion criteria included age over 30, low energy hip fracture, and creatinine availability in patient records. Patients undergoing hemodialysis or peritoneal dialysis were also excluded. According to the checklist of information including: creatinine, hemoglobin, underlying diseases including: diabetes, hypertension, ischemic heart disease, congenital kidney disease, obstructive kidney disease, polycystic kidney and glomerulonephritis. The eGFR of patients was calculated based on the chronic kidney disease epidemiology collaboration (CKD-EPI) formula and the first creatinine in the patient record. Mortality was also assessed in patients.

CKD-EPI formula:

GFR = 141 × min (sCr/κ, 1) α × max (sCr/κ, 1) -1.209 × 0.993Age × 1.018 [if female] × 1.159 [if black]

sCr = Serum creatinine based on mg / dl

K = 0.7 for women and 0.9 for men

α = 0.329 - for women and 0.411 - for men (12)

Patients were divided into two groups of 60 and over 60 based on eGFR. Data were analyzed by SPSS software version 24 using ANOVA, Chi square and descriptive statistics. Pearson correlation was also used to correlate the quantitative variables. Quantitative data were presented as mean and standard deviation and qualitative data as frequency or percentage. P-value less than 0.05 was considered significant.

RESULTS

In this study, 418 patients with low energy hip fractures were studied, 57.4% of which were female, the most frequent being intertrochanteric fracture (67.9%), 31.1% diabetes, 46.9% hypertension and 18.9% ischemic disease. They had heart disease and 1.7% of patients died. The mean eGFR in patients was 61.14±21.88. Between the patients who were studied, 203 (48.6%) had eGFR below 60 and 215 (51.4%) had eGFR above 60. Patients with eGFR below 60 were significantly more common, underlying diseases of diabetes and hypertension were significantly higher, and mean age and creatinine levels were significantly higher than those with high eGFR. The mean hemoglobin level in subjects with eGFR below 60 was significantly lower than those with eGFR above 60 ($p < 0.05$). Mortality was significantly higher in those with eGFR below 60 than in those with eGFR above 60. There was no significant relationship between eGFR and type of fracture and ischemia ($p > 0.05$) (Table 1).

DISCUSSION

In a study of 418 patients with low-energy hip fractures, the mean GFR in patients with lower extremity fractures was 61.14. In addition, one of the most important findings of our study was that the mean GFR in patients with diabetes or hypertension or ischemic heart disease was significantly lower than in patients who did not have the above diseases and also in patients who died GFR was significantly lower than patients who survived. There have been many studies on this, each of which is important. In a 2009 study by Nitsch and colleagues in the United Kingdom, they examined 13177 patients and examined the mortality of hip fractures in these patients with chronic renal failure.

They showed in this study that at GFR values below 45 ml / min / 1.73 m 2, the mortality rate due to hip fracture doubled (13). These results are in line with our results. We showed that in patients with mortality, the mean GFR was 35.01 and in patients without mortality, the mean GFR was 61.59. In another study by Dukas et al., They studied 1781 patients with osteoporosis and examined factors contributing to fractures, suggesting that a GFR of less than 65 increased the risk of fractures (14). The results of this study are also in line with our research. In this study, we showed that the mean GFR in patients with hip fracture was 61.14, which is consistent with the findings of the Dukas study. In another study by Dukas and colleagues, they showed that increasing age, along with GFR below 65, are independent risk factors for fractures, with hip, vertebral and radius fractures being the most common fractures (15). These results, together with the results of our study, indicate the importance of factors such as old age, reduced GFR and underlying disease in increasing the chance of fracture. In addition, we examined the relationship between these fractures and underlying disease and mortality in patients. In another study by Schneider et al., Lower extremity fractures were admitted in 1078 cases, and finally, by examining the underlying diseases in these patients, they found that diabetes was associated with factors such as chronic kidney failure. Can increase the risk of fractures in patients (16). This study confirms the results of our study. We found that 31.1% of patients with hip fracture had diabetes and also had a lower GFR than non-diabetics. Therefore, attention to the underlying diseases along with chronic kidney failure is considered important. A study by Jacques and colleagues found that renal failure and decreased renal clearance potency were associated with increased mortality in severely ill patients with increased lactate (17). One of the studies that examined the impact of renal disease on fractures is the study of Jørgensen et al. They showed that kidney problems, especially albuminuria, were associated with an increase in the percentage of non-vertebral fractures (18). These results are important because renal failure and its markers, the most important of which is the reduction of GFR, should be considered more carefully in poor patients than in other patients. As shown in this study, the mean GFR in patients with low energy hip fractures was lower than 65 and the mortality due to fractures was lower in patients with lower GFR. We showed that GFR decreased with age. These results, which are in line with previous studies, indicate the importance of renal failure in hip fracture and mortality.

CONCLUSION

According to the results of this study and other studies and with the high prevalence of hip fractures in patients with renal failure, management of these patients may be useful to reduce complications after fracture, because GFR in these patients with mortality It was connected. Therefore, further studies are needed.

Table 1. Study variables based on eGFR

Qualitative variable		**eGFR below 60**	**eGFR above 60**	**Total Frequency (Percent)**	***P*-value**
	Male	**61** (30%)	**117** (54.5%)	**178** (42.6)	**<0.001**
Sex	Female	142 (70%)	98 (45.6%)	240 (57.4 %)	
Type of	Right intertrochanteric	78 (38.4%)	68 (31.6%)	146 (34.9%)	
fracture	Left intertrochanteric	63 (31%)	75 (34.9%)	138 (33 %)	0.22
	Right femoral neck	20 (9.9%)	28 (13%)	48 (11.5%)	
	Left femur neck	32 (15.8%)	26 (12.1%)	58 (13.9%)	
	Right trochanteric	0	4 (1.9%)	4 (1%)	
	Left trochanteric	1 (0.5%)	0	1 (0.2%)	
	Right subtrochanteric	6 (3%)	9 (4.2%)	15 (3.6%)	
	Left subtrochanteric	3 (1.5%)	5 (2.3%)	8 (1.9%)	
Underlying disease	Diabetes	78 (38.4%)	52 (24.2%)	130 (31.1%)	0.001
	Hypertension	122 (60.1%)	74 (34.4)	196 (46.9%)	<0.001
	Ischemic heart disease	43 (21.2%)	36 (16.7%)	79 (18.9%)	0.15
	Morality	7 (3.4%)	0	7(1.7%)	0.006
	Quantitative variable	eGFR below 60	eGFR above 60	Mean	P-value
	Age (years)	79.4 (9.82)	72.86(13.74)	76.04 (12.42)	<0.001
	Creatinine (mg/dl)	1.5 (0.81)	0.93(0.15)	1.21(0.64)	<0.001
	Hb (mg/dl)	10.52(1.48)	11.97(1.5)	11.26(1.66)	<0.001

(Abbreviation; eGFR: estimated glomerular filtration rate, Hb: Hemoglobin)

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AUTHOR CONTRIBUTION
Study concept and design: M.M.; drafting of the manuscript: M.M.; critical revision of the manuscript for important intellectual content: M.M.

CONFLICT OF INTEREST
None.

ETHICAL STANDARDS
This study was approved by the School of Medical Education- Shahid Beheshti University of Medical Sciences. All the patients signed written consent before including the study.

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