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Risk Factors for Fracture Events in Maintenance Hemodialysis Patients

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Abstract: Objective: To explore risk factors for fracture events in maintenance hemodialysis patients. Methods: The study population was obtained from the hospital in patient database in China. There were 654 eligible patients with hemodialysis from 2018 – 2020. Other patient-related variables collected include gender, age, history of hypertension, history of diabetes mellitus, dialysis age, active vitamin D, hemoglobin, serum albumin, total cholesterol, triglyceride, serum corrected calcium. The primary outcome was any factors of fracture. Patients were followed until complete treatment or death. Besides, we performed subgroup analyses and used generalized linear models to assess interaction effects in logistic regressions. To clarify the relationship between fracture and risk factors, logistic regression was used. Result: By comparing non-fracture group and fracture group, we found that some factors were significantly difference, including gender, age, active vitamin D, and albumin (p = 0.001, p = 0.001, p < 0.001, p < 0.001). base on multivariate Logistic regression analysis of fracture occurrence in hemodialysis patients, older age, female, and low albumin were independent risk factors for fracture (p < 0.05). Also, the use of active vitamin D is a protective factor for fractures (p < 0.05). Conclusion: the risk factors for fracture events in maintenance hemodialysis patients included older age, female, low albumin, and active vitamin D.

Keywords: Maintenance Hemodialysis, Fracture, Risk Factors

1. Introduction

Hemodialysis is an essential renal replacement therapy, that is a chronic treatment to filter waste and water from blood [1], However, mineral and endocrine disorders are common in patients with maintenance hemodialysis (MHD), which will lead to changes in bone structure and function such as bone transport, mineralization and bone mass, leading to osteoporosis, high transport bone disease and non-dynamic bone disease in patients [2-4]. These are possible factors that contribute to a higher risk of fracture in dialysis patients than in the general population. Base on the reports of Tentori and Chang, they indicated that the rate of fracture in hemodialysis patients was significantly higher than in the general population, with 25.3 fractures per 1,000 dialysis patients, four times the rate of fracture in the general population, and a 3.7-fold increase in the risk of death from fracture [5, 6]. In addition, there was a significant increase in mortality and hospitalization within 1 month after fracture

[7]. This is why many researchers will focus on the influence factors of fracture in patients with maintenance hemodialysis.

Some reports attempt to investigate patients' lifestyle and diet to determine risk factors for fractures [8-10]. Despite their report robust results, but their data was difference between both of them. For example, Zhou and Chen's report shown that Chen think identified falls as a risk factor for fractures in patients with persistent hemodialysis, on the other hand, Zhou suggests that vitamin D deficiency is a risk factor for fracture in patients undergoing continuous hemodialysis [11, 12]. Therefore, the risk factors of fracture in continuous hemodialysis patients are a valuable study. The aim of this study was to explore risk factors for fracture events in maintenance hemodialysis patients.

2. Methods

2.1. Source of Data and Outcome

The study population was obtained from the hospital in patient database in China. There were 654 eligible patients with hemodialysis from 2018 to 2020. Criteria for entry into this study were that age was 18 years or older, and patients undergoing maintenance hemodialysis: chronic maintenance hemodialysis with less than 4 hours per session, more than 4 hours or more and loss than 5 hours per session, more than 5 hours per session or more, or chronic maintenance hemodiafiltration [13, 14]. Also, both traumatic and non-traumatic fractures were included in this study. We did not collected the data from pathological fracture and multiple fractures in the study. Other patient-related variables collected include gender, age, history of hypertension, history of diabetes mellitus, dialysis age, active vitamin D, hemoglobin, serum albumin, total cholesterol, triglyceride, serum corrected calcium. The primary outcome was any factors of fracture. Patients were followed until complete treatment or death.

The ethics committee of the Guangdong approved this study and waived the need for informed consent given the anonymity of the data. The study was performed in accordance with the ethical principles of the Declaration of Helsinki.

2.2. Data Analyses

Patient demographics and characteristics are presented as numbers and percentages. Comparisons of baseline characteristics between the groups were performed using t test for continuous variables and $\chi 2$ test for categorical variables. We performed subgroup analyses and used generalized linear models to assess interaction effects in logistic regressions. To clarify the relationship between fracture and risk factors, logistic regression was used.

3. Result

We collected the common data from 654 patients with maintenance hemodialysis, the common data consist of gender, age, history of hypertension, history of diabetes mellitus, dialysis age, active vitamin D, hemoglobin, serum albumin, total cholesterol, triglyceride, serum corrected calcium. We found that some factors were significantly difference, including gender, age, active vitamin D, and albumin (p = 0.001, p = 0.001, p < 0.001, p < 0.001). By comparing non-fracture group and fracture group, we assessed the possible relationship between fracture, female, age, active vitamin D, and albumin, as shown in Table 1 and Table 2.

Table 1. *Comparison of common data in maintenance hemodialysis patients (X^2 test).*

Item	Non-fracture group (n = 482)	Fracture group (n = 172)	X^2	P value
Female (n,%)	216 (44.8%)	128 (74.4%)	11.087	0.001
history of hypertension (n,%)	405 (84.0%)	121 (70.3%)	1.409	0.235
history of diabetes mellitus (n,%)	239 (49.6%)	101 (58.7%)	2.663	0.103
active vitamin D (n,%)	194 (40.2%)	17 (10%)	11.419	0.001

Table 2. *Comparison of common data in maintenance hemodialysis patients (T test and Z test).*

Item	Non-fracture group (n = 482)	Fracture group (n = 172)	T/Z	P value
Age (year) (mean±SD)	62±14	71±10	4.616	< 0.001
dialysis age (mouth) (P_{25}, P_{75})	71 (34,96)	73 (38,94)	0.028	0.867
Hemoglobin (g/L) (mean±SD)	112.52±14.67	108.31±16.99	0.402	0.688
serum albumin (g/L) (mean±SD)	38.78±4.47	34.19±3.54	4.489	< 0.001
total cholesterol (mmol/L) (mean±SD)	4.24±1.03	4.12±0.91	1.039	0.299
Triglyceride (mmol/L) (mean±SD)	2.03±1.14	2.15±0.49	0.722	0.472
serum corrected calcium (mmol/L) (mean±SD)	2.27±0.18	2.26±0.21	0.301	0.704

We analyse the common data which were significantly difference between non-fracture group and fracture group by multivariate Logistic regression analysis. The Table 3 shown that older age, female, and low albumin were independent risk factors for fracture (p < 0.05). Also, the use of active vitamin D is a protective factor for fractures (p < 0.05).

Table 3. *Multivariate Logistic regression analysis of fracture occurrence in hemodialysis patients.*

	Regression coefficient	Standard error	X^2	P value	OR value	95% CI for OR values
female	1.153	0.461	6.226	0.012	3.170	1.281~7.847
Age (per increase 10 years old)	0.502	0.221	5.227	0.022	1.640	1.069~2.544
active vitamin D (use)	-1.537	0.650	5.412	0.020	0.214	0.058~0.784
Albumin (Per decrease 5g/L)	0.784	0.285	7.406	0.007	2.191	1.253~3.832

4. Discussion

In this study, we demonstrated that some factors can affect fracture events in maintenance hemodialysis patients, such as gender, age, active vitamin D, and albumin. To explore the risk factors for fracture events in maintenance hemodialysis patients, we performed a cross section study and comparison of gender, age, history of hypertension, history of diabetes mellitus, dialysis age, active vitamin D, hemoglobin, serum albumin, total cholesterol, triglyceride, serum corrected calcium. We show fracture events was reduced by older age, female, low albumin, and active vitamin D.

As shown in Table 1 & Table 2, we found that gender, age,

active vitamin D, and albumin can affect the fracture events as these factors were significantly difference between non-fracture group and fracture group. As shown in Table 3, older age, female, and low albumin were independent risk factors for fracture, and the use of active vitamin D is a protective factor for fractures. The possible reason is that active vitamin D improves muscle strength and neuromuscular coordination, so much so that it reduces the risk of falls. active vitamin D reduced fracture events by reducing the risk of falls for the patient with maintenance hemodialysis. Therefore, the medical staffs should pay attention to the patient with maintenance hemodialysis who were older age or female or low albumin. And medical staffs should provide drug of active vitamin D to the patients.

Several studies in related fields clearly demonstrated that patients with chronic kidney disease who lack vitamin D have reduced bone density and an increased risk of fractures [13]. Likewise, active vitamin D supplementation may improve bone mineral density in patients with chronic kidney disease [14, 15].

In limitation, our subject were patients with maintenance hemodialysis, so it is not known whether our results are application to the patients who received other treatment.

5. Conclusion

In conclusion, the risk factors for fracture events in maintenance hemodialysis patients included older age, female, low albumin, and active vitamin D. of those, older age, female, and low albumin were independent risk factors for fracture, and the use of active vitamin D is a protective factor for fractures.

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