ORIGINAL ARTICLE

INTERTROCHANTERIC HIP FRACTURES AND VITAMIN D DEFICIENCY; A SIGNIFICANT ASSOCIATION

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Background: Intertrochanteric fractures are a common cause of disability, morbidity and mortality in aged population across the globe. The same population is also vulnerable to ill effects of vitamin D deficiency and presence of multiple comorbidities. Very few studies have been done in our part of the world to find the association of vitamin D deficiency with type of intertrochanteric fractures. **Methods:** This cross-sectional study was conducted during July 2019 to June 2020 at tertiary care hospital in the megacity of Lahore, Pakistan. Demographic variables were recorded and anteroposterior and lateral views of plain radiographs were used to classify the fractures. History of chronic illness was taken and confirmed with available prescription. Vitamin D level was measured using standard laboratory techniques. Data was entered into IBM SPSS Statistics (version 25) software and analysed. **Results:** Mean age for males was 65 years and for females 71 years. Boyd and Griffin type II fracture was most common injury (62%). 67% of our study population was suffering from some degree of vitamin D deficiency. Results have shown the significant association of vitamin D deficiency and severity of intertrochanteric fractures (p <0.05). There was no significant difference of degree of vitamin D deficiency and injury pattern among both genders. **Conclusion:** There is a strong association between degree of vitamin D deficiency and type of intertrochanteric fractures. Our study also highlighted the importance of mechanism of injury, age and presence of diabetes in association with these fractures.

Keywords: Intertrochanteric fracture; Vitamin D deficiency; Mechanism of injury; Boyd and Griffin classification; Old age

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INTRODUCTION

Hip fractures are one of the main causes of morbidity in aged population. Annually more than 3,00,000 patients, over the age of 65 years, are admitted in United States with hip fracture. Majority of these fracture are caused by low energy fall.[1]

As the elderly population increases, the morbidities associated with advanced age also increase. This population is especially vulnerable to have weaker bone, increased tendency to suffer a fall, multiple co-morbidities, side effects of medications and also poor diet. At present, world population aged over 60 years is estimated to be 12% which is expected to be increased to 22% by year 2050.[2] Pakistan is a developing country and increasing trend in life expectancy is seen. In Pakistan elderly population is 4% and it is expected to be doubled by year 2050.[3] Fracture pattern in this population is different from that in younger population.

Fractures around hip occur more commonly in aged because of multiple factors including poor balance, poor vision, osteoporosis, medication, and social deprivation. A community-based study from a megacity of Pakistan revealed that only about 8% of respondents over the age of 65 years were living without any chronic impairment. While 31% have one impairment, 38% have two and 23% have three or more than 3 impairements.[4]

Osteoporosis is mostly an age-related process. It is characterized by presence of decreased bone mass and microstructural problem to the bone.[5] Vitamin D deficiency is one of the factors responsible for development of osteoporosis. In the absence of vitamin D, only 10–15% of the dietary calcium and about 60% of the phosphorous get absorbed.[6] This leads to decreased strength and increase fragility which results into increased risk of fracture. Hip region, distal radius and spine are most commonly affected sites. The fractures of intertrochanteric region are most common and debilitating because of increased morbidity, disability and mortatlity.[7]

There is paucity of data from our country regarding the deficiency of vitamin D in relation to intertrochanteric fracture. Our primary objective was to find the association of different degree of vitamin D deficiency with Boyd and Griffin types of intertrochanteric fracture. Secondary objective was to find the statistical significance of presence or absence of chronic illnesses in regard to severity of these fractures. We also measured the effect of mechanism of injury on these fractures.

MATERIAL AD METHODS

A cross sectional study was conducted at department of orthopaedics and traumatology, Ittefaq Hospital (Trust), which is a large public sector hospital located in the megacity of Lahore, Pakistan. Data was collected from 1st Jul 2019 to 30th Jun 2020.

Consecutive sampling technique was used for data collection. Patients, who were diagnosed to have fracture of intertrochanteric area of femur based on radiographic evaluation, were included in the study. Patients, who had fracture of intertrochanteric region of femur but were skeletally immature, have isolated avulsion fracture of greater or lesser trochanter, have previous injury to same intertrochanteric area, or have pathological fracture, were excluded from the study.

Data was collected on computer-based forms. Data was stratified for age, gender, mechanism of injury and vitamin D level. Data was analysed using IBM SPSS STATISTICS (version 25) software. Patients were categorized based on their gender (male, female) and age (≤50 years, 51–70 years, 71–90 years and ≥91 years).

Type of intertrochanteric fracture was classified according to Boyd and Griffin Classification System.[8] Simple fractures with fracture line running between greater and lesser trochanter were classified as type I (Figure-1) , fracture with comminution of posteromedial cortex were classified as type II (Figure-2), fractures with at least one fracture line running into subtrochanteric area were classified as type III (Figure-3) and fractures extending into femoral shaft were classified as type IV (Figure-4).

Mechanism of injury was categorized as low energy if the trauma resulted due to fall from a standing height, intermediate energy if fracture occurred due to fall from a more than standing height but less than 6 feet e.g. fall from stairs or ladder. Injuries occurring due to road traffic accidents or fall from more than 6 feet height were regarded as high energy trauma.

Vitamin D level was measured in blood sample obtained through standard techniques in all these patients and results were grouped as severe deficiency (≤ 10ng/ml), moderate deficiency (11–20 ng/ml), mild deficiency (21–30 ng/ml), sufficiency (31–100 ng/ml) and toxicity (≥101 ng/ml).

Patients past medical history was searched for presence or absence of major comorbidities for patient was actively being managed by physician. Comorbidities include diabetes mellitus, hypertension, ischemic heart disease, chronic obstructive pulmonary disease and renal disease. History of steroid use was also recorded.

Continuous variables were reported as means and categorical variable as percentages. Post stratification Fischer Exact test was applied to assess the statistical significance (p<0.05) and relationship of type of intertrochanteric fracture with different categorical variables. Multivariate analysis was done by applying multinomial logistic regression to investigate the factors associated with different types of these fractures and statistical significance (p=0.05) was calculated with 95% confidence interval.

Figure-1

Figure-2

Figure-3

Figure-4

RESULTS

A total of 121 patients were presented with intertrochanteric hip fractures. Out of these 7 cases were excluded because in 4 patients the cause of fracture was metastatic bone disease and 3 patients were skeletally immature. 114 patients were included in final analysis. Out of these 54 (47.4%) were males and 60 (52.6%) were females. Mean age of male population was 66 years (SD=16.67) and that of female population was 71 years (SD=14.29). In males

mean level of vitamin D was 22.9 ng/ml (SD=11.63) while in females it was 27.0 ng/ml (SD=14.44). All categorical variables are analysed using Fischer Exact (FE) test and significant association of Boyd and Griffin Type with age groups, vitamin D level, mechanism of injury (Table-1) and different comorbidities (Table 2) was analysed.

There was statistically significant association between type of fracture and mechanism of injury, vitamin D level and Age group of patients (p<0.05). However, no association was found between gender and type of vitamin D (p>0.05).

These are the results from multinomial logistic regression investigating the factors associated with Boyd & Griffin Type of fracture (Type I of Boyd & Griffin served as reference category). In the model comparing Boyd & Griffin Type I with Type III and Type IV, Older patients are significantly more likely to have Type III (OR=1.07, CI=1.00-1.15) and Type IV (OR=1.10, CI=1.01–1.20) fracture.

In the model comparing to Boyd & Griffin Type I to Type II and Type III, those who have sufficient amount of Vitamin D level are less likely to have Type II (OR=0.94, CI=0.89–0.98) and Type III fracture (OR=0.92, CI=0.85–0.98).

In the model comparing to Boyd & Griffin Type I to Type III, those who have suffered from lower energy trauma and moderate energy trauma are less likely to have Type III fracture (OR_{LET}=0.02, CI_{LET}=0.00–0.33 and OR_{MET}=0.05, CI_{MET}=0.00–0.59).

In the model comparing to Boyd & Griffin Type I to Type IV, those who have suffered from lower energy trauma and moderate energy trauma are less likely to have Type IV fracture (OR_{LET}=0.00, CI_{LET}=0.00–0.27 and OR_{MET}=0.05, CI_{MET}=0.00–0.95).

Table-1: Correlation of Boyd & Griffin type and categorical variables

Variables		**Boyd & Griffin**				***p*-value**
		Type I	**Type II**	**Type III**	**Type IV**	
	Categories \ N	**21**	**71**	**15**	**7**	**–**
Age, n (%)	≤ 50	8 (47.1%)	5 (29.4%)	3 (17.6)	1 (5.9%)	FE =16.88, p=0.024
	51 to 70	5 (14.3%)	20 (57.1%)	8 (22.9%)	2 (5.7%)	
	71 to 90	7 (12.5%)	41 (73.2%)	4 (7.1%)	4 (7.1%)	
	≥ 91	1 (16.7%)	5 (83.3%)	0 (0.0%)	0 (0.0%)	
Gender, n (%)	Male	12 (22.2%)	30 (55.6%)	8 (14.8)	4 (7.4%)	FE =2.110, p = 0.560
	Female	9 (15%)	41 (68.3%)	7 (11.7%)	3 (5%)	
Mechanism of Injury, n (%)	Low Energy Trauma	12 (16.4%)	54 (74%)	5 (6.8%)	2 (2.7%)	FE =24.51, p =0.000
	Intermediate Energy Trauma	7 (26.9%)	14 (53.8%)	3 (11.5%)	2 (7.7%)	
	High Energy Trauma	2 (13.3%)	3 (20%)	7 (46.7%)	3 (20%)	
Vitamin D Level, n (%)	Severe Deficiency	0 (0.0)	8 (66.7%)	4 (33.3%)	0 (0.0%)	FE =17.62, p=0.020
	Moderate Deficiency	5 (13.2%)	25 (65.8%)	5 (13.2%)	3 (7.9%)	
	Mild Deficiency	2 (7.4%)	21 (77.8%)	2 (7.4%)	2 (7.4%)	
	Sufficiency	14 (37.8)	17 (45.9%)	4 (10.8%)	2 (5.4%)	
	Toxicity	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	

Table 2. Correlation of Boyd & Griffin type and comorbidities

Variables		**Boyd & Griffin**				***p*-value**
		Type I	**Type II**	**Type III**	**Type IV**	
	Categories\N	**21**	**71**	**15**	**7**	**–**
DM, n (%)	No	17 (20.7%)	54 (65.9%)	9 (11.0%)	2 (2.4%)	FE=8.153, p=0.036
	Yes	4 (12.5%)	17 (53.1%)	6 (18.8%)	5 (15.6%)	
HTN, n (%)	No	12 (18.2%)	44 (66.7%)	8 (12.1%)	2 (3.0%)	FE=3.048, p=0.383
	Yes	9 (18.8%)	27 (56.3%)	7 (14.6%)	5 (10.4%)	
IHD, n (%)	No	19 (19.8%)	60 (62.5%)	11 (11.5%)	6 (6.3%)	FE =2.027, p = 0.541
	Yes	2 (11.1%)	11 (61.1%)	4 (22.2%)	1 (5.6%)	
Renal Disease, n (%)	No	19 (18.4%)	62 (60.2%)	15 (14.6%)	7 (6.8%)	FE =2.015, p = 0.578
	Yes	2 (18.2%)	9 (81.8%)	0 (0.0%)	0 (0.0%)	
COPD, n (%)	No	18 (17.3%)	64 (61.5%)	15 (14.4%)	7 (6.7%)	FE =2.138, p = 0.491
	Yes	3 (30%)	7 (70%)	0 (0.0%)	0 (0.0%)	
Steroids Use, n (%)	No	20 (18.5%)	66 (61.1%)	15 (13.9%)	7 (6.5%)	FE=0.0812, p = 0.885
	Yes	1 (16.7%)	5 (83.3%)	0 (0.0%)	0 (0.0%)	
Comorbid, n (%)	No Comorbid	9 (18.4%)	32 (65.3%)	7 (14.3%)	1 (2%)	FE =5.272, p = 0.492
	1 Comorbid	11 (21.6%)	30 (58.8%)	5 (9.8%)	5 (9.8%)	
	More than 1 Comorbid	1 (7.1%)	9 (64.3%)	3 (21.4%)	1 (7.1%)	

DM = Diabetes Mellitus, HTN = Hypertension, IHD = Ischemic heart disease, COPD = Chronic Obstructive Pulmonary Disease

Presence of Diabetes Mellitus was statistically associated with intertrochanteric fracture (p=<0.05), while no other chronic illness had an observable effect.

Table-3: Multivariate analysis

Predictor		Odd Ratios	95% Confidence Interval	*p*-value
Boyd and Griffin Type II				
Age		1.048	[0.997–1.101]	0.064
Vitamin D Level		0.935	[0.894–0.978]	0.003
Gender	Male	0.4	[0.127–1.259]	0.117
	Female			-
Mechanism of Injury	Low Energy Trauma	0.774	[0.05710.44]	0.847
	Moderate Energy Trauma	0.698	[0.072–6.801]	0.757
	High Energy Trauma	-		
Boyd and Griffin Type III				
Age		1.072	[1.004–1.145]	0.038
Vitamin D Level		0.915	[0.854–0.98]	0.012
Gender	Male	0.44	[0.089–2.175]	0.314
	Female	-		-
Mechanism of Injury	Low Energy Trauma	0.016	[0.001-0.334]	0.008
	Moderate Energy Trauma	0.047	[0.004–0.587]	0.018
	High Energy Trauma	-	-	-
Boyd and Griffin Type IV				
Age		1.104	[1.013-1.204]	0.025
Vitamin D Level		0.934	[0.857-1.017]	0.116
Gender	Male	0.586	[0.082-4.212]	0.596
	Female	.	-	.
Mechanism of Injury	Low Energy Trauma	0.007	[0-0.267]	0.008
	Moderate Energy Trauma	0.052	[0.003-0.947]	0.046
	High Energy Trauma	.		
Reference Category Boyd & Griffin Type I				

DISCUSSION

Old age comes with a plethora of problems, both physically and mentally. As aged population is estimated to be doubled by year 2050, so is the number of hip fractures is expected to be increased.[1] Fractures of these brittle bones result in increased morbidity as well as mortality. Even after successful fixation, only 30–40% of patients achieve their pre-injury functional level, while 20–30% die and 50–60% get disabled.[9]

Presence of multiple comorbidities and prescription of multiple drugs for management of these illnesses further complicate the picture. Sabzwari *et al.* conducted a community-based study in Karachi, another megacity of Pakistan, and showed that two third of their study population was suffering from chronic illnesses.[4] Our hospital-based study also shows the similar trend with 65% of males and 60% of female suffering from one or more chronic comorbidities. Despite these large percentage of patients suffering from multiple comorbidities, no statistically significant association was found between presence or absence of comorbidities and type of intertrochanteric fracture.

A descriptive study from Sweden with large sample size showed that 21% were type I, 49% were type II and 23% were type III and IV cumulatively. This study also described the cause of injury as low energy in 83%, intermediate energy in 10% and high energy trauma in 6% of their study participants.[10] Swedish population is vastly different from that of Pakistan in term of demography and life style.[3] Although most of the injuries in our study population occurred due to low energy trauma but a significant number of injuries were also because of high energy trauma, which resulted in mostly type III and IV fractures.

Osteoporosis has been identified as a major health problem especially in elderly. Being old aged is also a risk factor for osteoporosis so is the suboptimal levels of vitamin D.[11,12] Many studies has shown that only about 20% of Pakistani population has normal level of vitamin D, irrespective of age group.[13,14] Condition is not different in other developing countries. Old age population is especially vulnerable to deficiency and ill-effects of deficiency of vitamin D. Previous studies have shown the elderly males to be more significantly affected by vitamin D deficiency than elderly females.[12,15] Our study population showed a different trend. Although elderly patients had more severe deficiency, there was no statistically significant difference of level of vitamin D between males and females.

CONCLUSION

Intertrochanteric fractures are one of the commonest fractures of elderly population without gender specification and in our study population these were significantly associated with vitamin D deficiency. Vitamin D deficiency and Diabetes mellitus were also significantly associated with severe form of these fracture. Although multiple illnesses were present in study population but their presence had

failed to show a significant association with these fractures.

Conflict of interest: No conflict of interest.

AUTHORS' CONTRIBUTION

ABJ: Literature search, Conceptualization of study design, data collection, data analysis, write-up, proof reading. MNHK: Literature search, data collection, write-up, proof reading. MS: Data analysis, data interpretation, write-up, proof reading.

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