RESEARCH ARTICLE

Potential hip fracture early death predictors – a retrospective analysis from prospective trauma registry

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Abstract

Objective: To explore the blood pressure, fracture anatomical site, and age as potential predictors of death within 3 months after proximal femoral fracture management.

Method: The retrospective study was conducted from June 2015 and March 2020 at the Aga Khan University Hospital, Karachi and comprised orthopaedic trauma registry data of isolated proximal femur fracture patients managed between June 2015 and March 2020. Data of those who expired within 3 months of the management was pooled in group A, while data of those who survived >3 months post-treatment formed group B. Blood pressure at the time of hospital admission was considered normal at 90-120mmHg systolic and 60-80mmHg diastolic. Data was analysed using SPSS version 19.0.

Results: Of the 242 patients, 9(3.7%) were in group A; 5(55.5%) males and 4(44.4%) females with median age 78 years (interquartile range: 7 years). There were 233(96.3%) patients in group B; 123(52.7%) females and 110(47.2%) males with median age 70 years (interquartile range: 17 years). In 12 months post-treatment, 16(6.6%) patients expired; 9(56.25%) in group A, and 7(43.75%) in group B. Age >75 years and femoral neck fractures had a significant positive relationship with death within 3 months of surgical management ($p<0.05$).

Conclusion: Patients with femoral neck fracture and aged ≥75 years were found to be at the risk of death within 3 months post-management.

Key Words: Proximal femur fracture, Trauma, Diastolic blood pressure, Femoral neck fracture, Death.
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Introduction

The reported incidence of proximal femoral fracture is 145.3 events per 100,000 person-years among patients aged 65-69 years, and up to 3,563 in those aged 95-99 years.[1] A study reported an incidence of 228 per 100,000 individuals per year.[2] Several studies have been conducted on mortality associated with proximal femoral fractures (PFFs), reporting one-month rate of 5.7% and 12-month rate of 20.2%.[3] In one study, the reported PFF mortality in 12 months was 15%.[4] Mortality of 8.6% in 3 months was reported in PFF patients aged 40 years or above. Notably, it has been observed that the elderly aged >90 years have an increased risk of death (54.7%) after PFF surgery.[5,6] Unfortunately, the exact PFF incidence data for Pakistani population is not available.

Due to changing treatment patterns and with the help of trauma registries, it has been observed that the mortality rate is declining.[7] Thus, trauma registries could help in highlighting the potential predictors and causes of PFF mortality and proposing better management plans.

Studies have been conducted on the effect of vital signs on adverse outcomes and/or mortality. In a study, in all age groups it was identified that after trauma, pre-hospital low or high systolic blood pressure (SBP) was related to mortality.[8] Additionally, instability of vital signs after an injury, including low SBP, high heart rate (HR), respiratory rate (RR), and low oxygen saturation, leads to adverse outcomes, including mortality, in elderly patients aged ≥75 years.[9]

It has been observed that patients who arrived with hip fractures, perioperatively as well as postoperatively, developed hypotension with low SBP that might be a mortality risk factor.[10]

It was observed that elderly age, delay in surgery, and American Society of Anaesthesiologists (ASA) scores 3-4 were risks for one month and one-year mortality after PFFs. Mortality in neck of femur (NOF) fractures was less compared to other PFFs.[3] In addition, it was observed that NOF fracture patients of older age were at higher risk of mortality within 30 days.[11,12]

The one-year mortality was estimated to be 26.8% in PFF patients, with the mortality risk factors being age 70 years and above, hypertension (HTN), cardiac problems, chronic

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obstructive pulmonary disease (COPD), obesity, osteoporosis, etc.[13]

The current study was planned to explore blood pressure (BP), fracture anatomical site, and age as potential predictors of death within 3 months after PFF management in a tertiary care setting.

Materials and Methods

The retrospective study was conducted from June 2015 to March 2020 at the Aga Khan University Hospital, Karachi and comprised orthopaedic trauma registry data of isolated proximal femur fracture patients managed between June 2015 and March 2020. Data of those who expired within 3 months of the management was pooled in group A, while data of those who survived >3 months post-treatment formed group B. Data was retrieved from the single-centre, prospective, longitudinal orthopaedic trauma registry records after approval from the institutional ethics review committee. The registry is maintained on the basis of consent obtained from all patients at before the surgery, and carried data of follow-ups at 2 and 6 weeks, followed by 3, 6 and 12 months post-intervention. . Data of pathological, metabolic, stress fractures, and limb amputations was excluded. The sample size was calculated using OpenEpi software[14] in line with literature.[15]

Injury characteristics, fracture type and vital signs were recorded at the time of patients' arrival at the hospital. BP was categorised as normal on the basis of SBP 90-120mmHg and diastolic BP (DBP) 60-80mmHg. Age was divided into <75 years and ≥75 years categories.

Data was analysed using SPSS version 19.0. Quantitative data was expressed as means +/- standard deviation or median with iinterquartile range (IQR), as appropriate, while frequencies and percentages were used for qualitative variables. Data normality was evaluated using the Shapiro-Wilk test. Post-treatment functional outcomes were assessed using the Harris Hip Score. Fisher Exact test as 2x2 contingency tables was applied between the groups for NOF versus other proximal femoral fractures, age categories, gender and functional outcomes. Individual comorbid conditions were stratified as per group. For multiple comparisons of DBP and SBP categories, Fisher exact test with Bonferroni correction was applied. The Phi coefficient was investigated to further assess the strength of the association of death within 3 months with NOF fracture and age category. Mann-Whitney U test was used to assess the median difference in BP, RR, HR, and temperature between the groups. To assess the confounding effect of comorbidity, neurological disorders and disability on the likelihood of death within 3 months after PFF management, binary logistic regression analysis was performed. The association of these variables was further analysed by using the Fisher exact test. For all statistical values, $p<0.05$ was considered significant with 95% confidence interval (CI)

Results

Of the 258 records evaluated, 242(93.8%) were included. Of these 242 patients with median age 70 years (IQR: 16 years), 9(3.7%) were in group A; 5(55.5%) males and 4(44.4%) females with median age 78 years (IQR: 7 years). There were 233(96.3%) patients in group B; 123(52.7%) females and 110(47.2%) males with median age 70 years (interquartile range: 17 years). The most common cause of injury was fall, followed by road traffic accidents (RTAs) (Table 1). In 12 months post-treatment, 16(6.6%) patients expired; 9(56.25%) in group A, and 7(43.75%) in group B, with the most common reason being sepsis (Table 2).

Between the groups, age >75 years and NOF fractures had

Table-1: Proximal femur fracture patients and injury characteristics.

Characteristics (total N=242)	Cases group (N=9)	Control group (N=233)
Age (years)	78 (IQR=7)	70 (IQR=17)
Gender	Males (*N=5*, 55.5%) Females (N=4, 44.4%)	Males (N=110, 47.2%) Females (N=123, 52.7%)
Fracture Type	Neck *of* femur (*N=7*, 77.7%) *Intertrochanteric*, (N=2, 22.2%)	Intertrochanteric (N=131, 56.2%) Neck of femur (N=73, 31.3%) Sub trochanteric (N=17, 7.2%) Greater trochanter N=02, 0.8%) Concurrent two proximal femoral fracture (N=10, 4.2%)
Mechanism of injury	*Ground level fall (N=09, 100%)*	*Ground level fall (N=182, 78.1%)* Fall from height (N=18, 7.7%) Road traffic accident (N=26. 11.1%) Firearm injury (N=3, 1.2%) Blunt trauma or assault (N=4, 1.7%)

Table-2: Post-procedure expiry time and cause of death in proximal femur fracture patients.

Cause of death (N=16 total deaths)	Cases group (N=9, expiry time)	Control group (N=7 of 233 died, expiry time)
Sepsis	N=6, within 2 months	N=2, between 3 to 6 months
Cardiogenic shock	N=2, within 3 months	-
Meningioma	-	N=1, 6 months
Aspiration pneumonia	-	N=1, 7 months
Unknown cause	N=1, 6 weeks	N=1, 9 months
Non-surgical cause	-	N=2, between 5 to 9 months

Table 3: Intergroup comparison of age, blood pressure and fracture type.

Comparison		Cases group (N=9)	Control group (N=233)	p-value	Phi coefficient, p-value
Proximal femoral fracture type	**NOF fracture**	*N=7* (77.7%)*	*N=78 (33.4%)*	*p*=0.01	ϕ=0.17, p=0.006
	Other proximal femoral fractures	*N=2 (22.2%)*	*N=155 (66.5%)*		
Age Categories	**< 75 years**	*N=1 (11.1%)*	*N=155 (66.5%)*	*p*=0.001	
	≥ 75 years	*N=8* (88.8%)*	*N=78 (33.4%)*		ϕ=0.22, p=0.001
Blood Pressure Categories	**SBP mmHg**			NS	
	High (≥121) *Normal (90–120)* *Low (<90)*	High *N=8 (88.8%)* Normal *N=1 (11.1%)*	High *N=194 (83.2%)* Normal *N=39 (16.7%)*		-
	DBP mmHg			NS	
	High (≥80)	High *N=3 (33.3%)*	High *N=76 (32.6%)*		-
	Normal (60–80)	Normal *N=3 (33.3%)* Low *N=3 (33.3%)*	Normal *N=135 (57.9%)*		
	Low (<60)		Low *N=22 (9.4%)*		
Blood Pressure (Mean/median)	**SBP mmHg** (mean±SD/median, IQR)	154±21	140, 28	NS	
	DBP mmHg (mean±SD/median, IQR)	76, 34	76±13		

NS: Non-significant difference, NOF: Neck of femur, SBP: Systolic blood pressure, DBP: Diastolic blood pressure*: Significant difference, ϕ: Phi coefficient

Table-4: Comorbid conditions in the study groups

Comorbid condition	Control group N (% of 233)	Cases group N (% of 9)
None	50 (21.4)	1 (11)
Hypertension	24 (10.3)	2 (22.2)
Diabetes mellitus	9 (3.8)	0
Diabetes mellitus, Hypertension	19 (8.1)	0
Hypertension, Diabetes mellitus, carcinoma	4 (1.7)	0
Diabetes mellitus, Hypertension, ischaemic heart disease, one-eye blindness	1 (0.4)	0
Ischaemic heart disease	4 (1.7)	0
Ischaemic heart disease, Hypertension	9 (3.8)	0
Asthma	2 (0.8)	0
Diabetes mellitus, ischaemic heart disease	5 (2.1)	0
Diabetes mellitus, Hypertension, gastritis	1 (0.4)	0
Psychiatric problems, Hypertension	2 (0.8)	0
Hypertension, Rheumatoid arthritis, Chronic obstructive pulmonary disease	1 (0.4)	0
Diabetes mellitus, chronic liver disease, ischaemic heart disease, Hepatitis C	1 (0.4)	0
Diabetes mellitus, Hypertension, ischaemic heart disease, hypothyroidism	1 (0.4)	0
Hypertension, osteoarthritis	1 (0.4)	0
Ischaemic heart disease, Hypertension, bilateral knee replacement	1 (0.4)	0
Diabetes mellitus, Hypertension, asthma	3 (1.3)	0
Asthma, Hypertension	3 (1.3)	0
Diabetes mellitus, Hypertension, Chronic obstructive pulmonary disease	1 (0.4)	0
hypothyroidism	3 (1.3)	0
gastritis	1 (0.4)	0

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Haemangioma		
liver, chronic kidney disease	1 (0.4)	0
Hepatitis C	2 (0.8)	0
Diabetes mellitus, Hypertension, ischaemic heart disease	10 (4.3)	0
Hypertension, carcinoma	3 (1.3)	0
Hypertension, Chronic obstructive pulmonary disease	1 (0.4)	0
Diabetes mellitus, Hypertension, asthma, stroke	1 (0.4)	0
Diabetes mellitus, Hypertension, benign prostatic hyperplasia	2 (0.8)	0
Diabetes mellitus, Hypertension, cerebrovascular accident	3 (1.3)	0
Peptic ulcer, benign prostatic hyperplasia	0	1 (11)
Hypothyroidism, Hypertension	1 (0.4)	0
Ischaemic heart disease, Hypertension, benign prostatic hyperplasia	1 (0.4)	0
Diabetes mellitus, Hypertension, ischaemic heart disease, chronic kidney disease	2 (0.8)	2 (22.2)
Diabetes mellitus, Hypertension, kidney disease	3 (1.3)	0
Diabetes mellitus, Hypertension, CNS disease	5 (2.1)	0
Tuberculosis, osteoarthritis	1 (0.4)	0
Diabetes mellitus, Hypertension, Hepatitis C	1 (0.4)	0
Psychological	1 (0.4)	0
Osteoporosis, Hypertension, Benign prostatic hyperplasia	1 (0.4)	0
Osteoporosis, Hypertension	3 (1.3)	0
eczema/allergy	1 (0.4)	0
osteoarthritis	2 (0.8)	0
Diabetes mellitus, Hypertension, osteoarthritis, dementia	1 (0.4)	0
Diabetes mellitus, Hypertension, ischaemic heart disease, asthma	2 (0.8)	0
Chronic obstructive pulmonary disease, hypothyroidism, chronic kidney disease	1 (0.4)	0
Haemophilia, Total knee replacement	1 (0.4)	0
Hypertension, Diabetes mellitus, past left hip replacement	1 (0.4)	0
Diabetes mellitus, Hypertension, osteoarthritis, asthma	1 (0.4)	0
Osteoarthritis, blindness	1 (0.4)	0
Hypertension, CNS vasculitis	1 (0.4)	0
Hypertension, lumbar stenosis, osteoporosis	1 (0.4)	0
Hypertension, ischaemic heart disease, osteoarthritis	1 (0.4)	0
Diabetes mellitus, Hypertension, chronic liver disease,	2 (0.8)	0
Diabetes mellitus, Hypertension, hypothyroidism	2 (0.8)	0
Benign prostatic hyperplasia	2 (0.8)	0
Hypertension, ischaemic heart disease, Parkinson's disease, bilateral TKR	1 (0.4)	0
CNS disease, Hypertension	2 (0.8)	0
BPH, Hypertension	1 (0.4)	0
Ischaemic heart disease, Hypertension, Diabetes mellitus, bilateral knee replacement, dementia, osteoporosis	1 (0.4)	0
Diabetes mellitus, Hypertension, ischaemic heart disease, osteoarthritis, asthma	1 (0.4)	0
Hypertension, ischaemic heart disease, hypothyroidism	1 (0.4)	0
Hypertension, ischaemic heart disease, Diabetes mellitus, carcinoma	1 (0.4)	0
Tuberculosis, Diabetes mellitus	1 (0.4)	0
Polio	1 (0.4)	0
Hypertension, femur THR, osteoporosis	1 (0.4)	0
Hypertension, ischaemic heart disease, chronic kidney disease	1 (0.4)	0
Hypertension, past total knee replacement, osteoporosis, rheumatoid arthritis	1 (0.4)	0
BPH, Hypertension, Chronic kidney disease	0	1 (11)
Asthma, pulmonary aspergillosis	1 (0.4)	0
Hypothyroidism, Hypertension, hepatitis C, Chronic kidney disease	0	1 (11)
Hypertension, Diabetes mellitus, left hip replacement, osteoporosis	1 (0.4)	0
Hypertension, kyphosis, osteoporosis, bronchiectasis	1 (0.4)	0
Cancer	2 (0.8)	1 (11)
CNS disease/problem	4 (1.7)	0
low ejection fraction/valvular heart disease	3 (1.3)	0
Total	233	9

CNS: Central nervous system, TKR: Total knee replacement, BPH: Benign prostatic hyperplasia, THR: Total hip replacement.

a significant positive relationship with death within 3 months of surgical management (Table 3), but the relationship between age category and fracture type was not significant (p=0.8). Also, the difference was no-significant between the groups with respect to RR, HR and body temperature (p>0.05).

Comorbidity, neurological disorders and disability had non-significant association with early death (p>0.05) (Table 4).

Functional outcomes between the groups at 2 and 6 weeks post-intervention were not significantly different (p=1.0).

In group A, the procdure was total hip replacement (THR) in 2(22.2%) cases, bipolar hemiarthroplasty 3(33.3%), dynamic hip screw (DHS) 2(22.2%), Thompson hemiarthroplasty 1(11.1%) and Austin Moore hemiarthroplasty 1(11.1%). Patients in group B were treated with non-operated or conservative treatment in 7(3%) cases, DHS 82(35.1%), bipolar hemiarthroplasty 34(14.6%), THR 26(11.1), closed reduction internal fixation (CRIF) with DHS 17(7.3%), proximal femoral nail antirotation (PFNA) 12(5.1%), open reduction internal fixation (ORIF) with DHS 7(3%), CRIF with cannulated screw fixation 7(3%), intramedullary (IM) nailing 6(2.5%), ORIF 4(1.7%), DHS with spiral blade 4(1.7%), Austin Moore hemiarthroplasty 3(1.3%), IM nailing with spiral blade 3(1.3%), racoon nail 3(1.3%), CRIF with DHS revision THR 2(0.8%), bipolar hemiarthroplasty with tension band wire (TBW) 1(0.4%), ORIF with IM nail 1(0.4%), ORIF with bone morphogenic proteins (BMP) 1(0.4%), ORIF with PFNA 1(0.4%), spiral blade nail 1(0.4%), dynamic condylar screw 1(0.4%), IM nailing with spiral blade and BMP 1(0.4%), IM nailing with Illizarov 1(0.4%), racoon nail with CRIF 1(0.4%), DHS with cerclage wire 1(0.4%), DHS with gentamycin beads 1(0.4%), THR with revision relocation prosthesis 1(0.4%), bipolar hemiarthroplasty revision arthrotomy 1(0.4%), bipolar hemiarthroplasty revision relocation prosthesis 1(0.4%), cannulated screw fixation 1(0.4%), CRIF 1(0.4%), and TBW 1(0.4%). Almost all surgical procedures performed in group A were also performed in group B. It seems that the surgical procedures possibly did not have effect on early death after treatment.

Discussion

Considering the increased risk of deaths within three to six months of death after the management of PFFs, and the limited evidence on vitals and fracture type as potential risk factors[3,10,16] the current study particularly focussed on fracture type, vital signs and age to identify potential predictors for each within 3 months of PFF management. The findings demonstrated that the most common mechanism of PFF was fall, particularly at the ground level. Females were identified to be more prone to PFFs, which supported earlier evidence.[17, 18]

While several studies have been conducted on the predictors of death in several surgical interventions, including high-risk hip fracture patients,[3,11,13,19] very few studies have explored NOF fractures as potential predictors of early death.[3,11,13,19] In the context of age and with changing treatment modalities, it has been reported that after a hip fracture, there was a 22-52% decrease in the 30-day and 31-365-day adjusted mortality rate ratio in different age groups in the 2010-14 period than in the 1980-84 period.[20] One study reported a five times increased risk of death within a year in hip fracture female patients who were aged 65-69 years. The risk decreased as age increased.[21] In another study, it was observed that hip fracture patients aged >75 years were significantly at risk of mortality within 12 months. It was also found that male patients and certain comorbid conditions increased the risk of death after hip fracture.[22] Previous research has shown that elderly patients with PFFs has a higher risk of death, particularly in the 30 days and first year of fracture.[11-13]

The current findings on PFF patients support these findings. Importantly, it was observed that more than two-thirds of patients group A compared to one-third in group B sustained NOF fractures. A positive association was observed between NOF fracture and death within three months of treatment. This finding suggests that patients with NOF fractures are at a higher risk of death compared to patients with other PFFs, and supports reported findings.[19]

On the contrary, some studies explored one-year mortality in elderly patients, and identified lower or almost equal deaths in NOF fracture compared to other fractures.[3,13,23]

Further, cardiovascular and renal problems could increase the risk of death in NOF fractures.[5] This indicates that the risk of death varies due to multiple factors. Thus, based on current findings on NOF fractures and age predisposition to early death, proper evaluation of patients with a high risk of death is warranted.

The present study has limitations owing to a relatively small sample size, particularly in group A. Larger studies are needed to validate the current findings.

Conclusion

Patients aged ≥75 years and having NOF fractures were likely to be at a higher risk of death within three months post-intervention related to PFF management.

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TA: Data interpretation, questionnaire design and provided feedback with the critical review.

ZAM: Concept, literature search, data collection, analysis and writing.