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Assessing risk factors of 1 year mortality in patients with hip fractures: A hospital-based retrospective cohort study from a developing level 1 trauma centre in Northern India

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Abstract

Purpose: Proximal femoral fracture is one of the major causes of morbidity and mortality in elderly group patientswith 11-23% of mortality is reported to occur at 6 months and 22-29% at 1 year. Despite the huge burden of osteoporosis, there is paucity of data regarding epidemiology, risk factors and outcome of fragility hip fractures in Indian population. As most of the published literature are from western world, we conducted the study to look for risk factors for early-mortality in hip fracture in Indian sub-continent and compare the same with published literature.

Methods: Total of 174 patients were available for final evaluation. Primary outcome was to see the mortality in elderly patients undergoing operative treatment and the secondary outcome measures were predictors of mortality in this age group with regard to age, sex, Charlson comorbidity index, injury severity score, pre-operative ASA grading, injury-surgery duration and length of hospital stay. Cox proportional regression hazards regression modelling was performed to assess the effect of different variables on time of mortality.

Results: Mean age of the patients was 70.56 (± 8.05) years. Mean Charlson Comorbidity Score was 1.68 (± 1.54; 2SD). Mean time from injury to operation time was 35.59 (±19.02; 2 SD) hours and the mean length of hospital stay was 4.78 (± 1.68; 2 SD) days. Mortality at one-year after surgery was 18.4%.On univariate and multivariate regression analysis variables significantly associated ($p<0.05$) with 'Mortality' are: Age, Charlson Index, Charlson Index Category, Injury to operation time(Hours), Length of hospital stay and pre-operative ASA grade.

Conclusion: We suggest that, without a dedicated hip-fracture protocol in a resource-poor set-up, early aggressive management to optimize patients for surgery and surgical intervention as soon as feasible lead to early return to pre-fracture status and reduces early mortality.

Keywords: Proximal femur fracture, mortality, risk factor, elderly

Introduction

Hip fractures have been a historical cause of morbidity and mortality in elderly population. With the advancement of medical care facility, the population of elderly is increasing drasticallyleading to more occurrence of hip fractures in this population[1]. Proximal femoral fracture is one of the major causes of morbidity and mortality in elderly group patientswith 11-23% of mortality is reported to occur at 6 months and 22-29% at 1 year[2]. In 1990, the occurrence of hip fracture in Asia was 26%, which was expected to rise to 37% in 2025 and to 45% in 2050[3]. It had been estimated that 1 in 3 women and 1 in 12 men will sustain a hip fracture in their lifetime[4].The first year after a hip fracture appears to be the most critical time with a mortality of 10% at one month and 30% at one year[5].The relative risk of mortality in the elderly patient population increases 4% per year[6].Time from injury to operation is a critical time as it is only a modifiable entity to prevent early mortalityas surgical delay has been associated with an increased length of stay and a higher risk of postoperative complications[7-10]but the exact association of it with mortality is less clear. A meta-analysis has found that a surgical delay of more than forty-eight hours increases mortality[11]. To date, no adverse effects of a short surgical delay (less than forty-eight hours) have been identified[10].

Despite the huge burden of osteoporosis, there is paucity of data regarding epidemiology, risk factors and outcome of fragility hip fractures in Indian population. As most of the published literature are from western world, we conducted the study to look for risk factors for early-mortality in hip fracture in Indian sub-continent and compare the same with published literature.

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Methodology

Specifics were collected retrospectively from patients, aged 65 years or more, who underwent surgical treatment for proximal femur fractures (femur neck and/or intertrochanteric fracture) between 1st April 2018 to 31st March 2019 at our level 1 trauma center. For the purpose of the study proximal femoral fracture was defined as fracture of neck of femur and/or per-trochanteric fractures. Patients treated non-operatively or who was not fit for surgery and pathological fractures were excluded from the study.

Total of 196 patients were operated in said duration out of which 22 patients were lost to follow up and 1-year follow up data were available for 174 patients.

All the patients were admitted through emergency where they were managed according to the ATLS protocol initially followed by radiological investigations.

Demographics and epidemiological data, such as age, gender, mode of injury, time of injury, associated injuries and co-morbidities, were collected as per study performa. Charlson Co-morbidity Index (CCI) was used to assess associated co-morbidities of patients & their impact on patient survival rate and Injury Severity Score (ISS) was used for assessing overall severity of trauma.

For the purpose of categorization, Charlson scores were grouped into four previously established indices to stratify severity of associated co-morbidities: 0 points (None), 1-2 points (Low), 3-4 points (Moderate) and > or =5 points(High). Interdepartmental consultations were sought as per need for optimization of patients peri-operatively. Data on time since injury to surgery, duration of surgery, method of fixation and length of hospital stay were also tabulated accordingly.

DVT prophylaxis was given in all patients, with Low-molecular weight heparin in-hospital and with aspirin at discharge. All patients were advised for partial weight bearing after surgery except those with spinal and lower limb fractures. Patients were followed up with x-rays at 1, 3, 6 months and 1 year respectively.

Primary outcome of this study is to see the mortality in elderly patients undergoing operativetreatment for proximal femoral fractures and the secondary outcome measures were predictors of mortality in this age group with regard to age, sex, Charlson comorbidity index, injury severity score, pre-operative ASA grading, injury-surgery duration and length of hospital stay. Data on mortality was collected by communicating with patient or family members telephonically.

Statistical analysis

Data were put in MS Excel spreadsheet program. SPSS v23(IBM Corp.) was used for data analysis. Group comparisons for continuously distributed data were made using independent sample 't' test when comparing two groups. If data were found to be non-normally distributed, appropriate non-parametric tests, such as Wilcoxon Test, were used for these comparisons. Chi-squared test was used for group comparison for categorical data. In case the expected frequency in the contingency table was found to be <5 for>25% of the cells, Fisher's exact test was used instead. Cox proportional regression hazards regression modelling was performed to assess the effect of different variables on time of mortality. Statistical significance was kept at $p<0.05$.

Result

Data collected from all 174 patients, who presented during the study period and met the inclusion criteria of the study, are summarized in Table 1. For the purpose of the study, the authors included fracture of femoral neck and trochanteric fractures. Mean age of the patients was 70.56 (± 8.05) years. Majority (57.5%) of the patients who underwent operative fixation were female. In our study most common mode of injury was fall from standing height that constituted 75.3% of total cases, followed by road traffic accident (16.1%). About two-thirds of the injuries involved trochanteric region (67.8%) while about one-third was fracture of femoral neck (31.6%). Most common method of fixation was proximal femoral nail (PFNA, AO Synthes) followed by dynamic hip screw. Patients with fracture neck of femur in this age group were uniformly treated with arthroplasty. Mean Charlson Comorbidity Score was 1.68 (± 1.54; 2SD). Mean time from injury to operation time was 35.59 (±19.02; 2 SD) hours and the mean length of hospital stay was 4.78 (± 1.68; 2 SD) days. Though most common mechanism in our cohort was low-velocity fall from standing height, a significant proportion (10.9%) had associated injury to other body-regions. Hence ISS was also included in the evaluation and mean Injury Severity Score was 9.05 (± 0.34) in our group. Mortality at one-year after surgery was 18.4% with mean time to mortality from surgery being 316.30 (± 110.26;2SD) days.

On multivariate regression analysis variables significantly associated ($p<0.05$) with 'Mortality' are (Table 2): Age, Charlson Index, Charlson Index Category, Injury to operation time (Hours), Length of hospital stay and pre-operative ASA grade, each factor having p value less than 0.001.

Patient with age >75 years had a significantly increased risk of mortality (Hazard Ratio=3.63, $p<0.00$) compared to patients aged less than 75. The coefficient for the Category 2-3 of Charlson Index was significant ($HR = 2.98$, $p = .027$) with a hazard ratio of 2.98 indicating that patient in category 2-3 category will have 2.98 times more risk of mortality compared to those in Charlson category 0-1. The coefficient for category 4 and above of Charlson Index was also significant ($HR = 10.34$, $p< .001$) with hazard ratio of 10.34 indicating that, patients in these higher (≥4) categories will have 10.34 times higher risk of mortality compared to 0-1 category. Coefficient for Injury-to-Surgery time 24-48 hours had no significant ($HR = 0.68$, $p = .421$) association with mortality. Though same cannot be stated for longer delay in surgery as the coefficient for Injury-Operation time of more than 48 hours was significant ($HR = 4.67$, $p< .001$) with 4.67 times more risk of mortality of patients in this category compared to whohad been operated earlier. Association between mortality and more than 4 days of

hospital stay was significant (p = .002) with a Hazard Ratio of 3.31 compared to patients with less than 4 days of stay. Pre-operative ASA Grade II, though was not found to have significant association with mortality (p = .054), had a Hazard Ratio of 2.76. Coefficient for ASA Grade III and grade IV were significant (HR = 5.65, p< .001) and had 5.65 and 13.45 times higher risk of mortality compared to ASA grade I respectively. Table 3 shows the Cox Proportional

Hazard Regression coefficients and Kaplan-Meier Survival plot for Age, Charlson Index category, Injury to Operation time, Length of Hospital stay and ASA Grade.

Table 1: Summary of All Parameters

All Parameters	Mean ± SD || Median (IQR) || Min-Max || Frequency (%)
Age (Years)	70.56 ± 8.05 || 69.00 (10.00) || 60.00 - 95.00
Age	
≤75 Years	132 (75.9%)
>75 Years	42 (24.1%)
Gender	
Male	74 (42.5%)
Female	100 (57.5%)
Mode of Injury	
RTA	28 (16.1%)
Fall from Standing Height	131 (75.3%)
Fall From 12 Feet Height	15 (8.6%)
Diagnosis	
Intertrochanteric Fracture	118 (67.8%)
Neck of Femur Fracture	55 (31.6%)
Neck + Shaft of Femur Fracture	1 (0.6%)
Laterality	
Right	85 (48.9%)
Left	89 (51.1%)
Method of Fixation	
Proximal Femoral Nailing	119 (68.4%)
Bipolar Hemiarthroplasty	52 (29.9%)
Dynamic Hip Screw	3 (1.7%)
Charlson Index	1.68 ± 1.54 || 2.00 (3.00) || 0.00 - 6.00
Charlson Index Category	
0-1	85 (48.9%)
2-3	65 (37.4%)
≥4	24 (13.8%)
Injury to Operation Time (Hours)	35.59 ± 19.02 || 32.50 (18.00) || 10.00 - 122.00
Injury to Operation Time	
≤24 Hours	63 (36.2%)
24-48 Hours	82 (47.1%)
>48 Hours	29 (16.7%)
Length of Hospital Stay (Days)	4.78 ± 1.68 || 4.00 (1.00) || 3.00 - 12.00
Length of Hospital Stay	
≤4 Days	99 (56.9%)
>4 Days	75 (43.1%)
ASA Grade	
I	84 (48.3%)
II	48 (27.6%)
III	33 (19.0%)
IV	9 (5.2%)
ISS Score	9.05 ± 0.34 || 9.00 (0.00) || 9.00 - 13.00
Mortality (Present)	32 (18.4%)
Time to Mortality	316.30 ± 110.26 || 365.00 (0.00) || 7.00 - 365.00

Table 2: Association between Mortality and Parameters

Parameters	Mortality		p value
	Present(n = 32)	Absent(n = 142)	
Age (Years)* **	75.59 ± 9.70	69.43 ± 7.20	0.001[1]
Age* **			<0.001[2]
≤75 Years	16 (12.1%)	116 (87.9%)	
>75 Years	16 (38.1%)	26 (61.9%)	
Gender			0.302[2]
Male	11 (14.9%)	63 (85.1%)	
Female	21 (21.0%)	79 (79.0%)	
Mode of Injury			0.148[2]
RTA	5 (17.9%)	23 (82.1%)	
Fall from Standing Height	27 (20.6%)	104 (79.4%)	
Fall From 12 Feet Height	0 (0.0%)	15 (100.0%)	
Diagnosis			0.864[3]
Intertrochanteric Fracture	21 (17.8%)	97 (82.2%)	

Neck of Femur Fracture	11 (20.0%)	44 (80.0%)	
Neck+Shaft of Femur Fracture	0 (0.0%)	1 (100.0%)	
Laterality			0.155[2]
Right	12 (14.1%)	73 (85.9%)	
Left	20 (22.5%)	69 (77.5%)	
Method of Fixation			0.609[3]
Proximal Femoral Nailing	21 (17.6%)	98 (82.4%)	
Bipolar Hemiarthroplasty	10 (19.2%)	42 (80.8%)	
Dynamic Hip Screw	1 (33.3%)	2 (66.7%)	
Charlson Index* **	2.84 ± 1.71	1.42 ± 1.38	<0.001[1]
Charlson Index Category* **			<0.001[2]
0-1	6 (7.1%)	79 (92.9%)	
2-3	13 (20.0%)	52 (80.0%)	
≥4	13 (54.2%)	11 (45.8%)	
Injury to Operation Time (Hours)* **	50.22 ± 27.27	32.30 ± 14.86	0.001[1]
Injury to Operation Time* **			<0.001[2]
≤24 Hours	9 (14.3%)	54 (85.7%)	
24-48 Hours	8 (9.8%)	74 (90.2%)	
>48 Hours	15 (51.7%)	14 (48.3%)	
Length of Hospital Stay (Days)* **	6.12 ± 2.27	4.48 ± 1.36	<0.001[1]
Length of Hospital Stay* **			0.001[2]
≤4 Days	10 (10.1%)	89 (89.9%)	
>4 Days	22 (29.3%)	53 (70.7%)	
ASA Grade* **			<0.001[2]
I	6 (7.1%)	78 (92.9%)	
II	9 (18.8%)	39 (81.2%)	
III	12 (36.4%)	21 (63.6%)	
IV	5 (55.6%)	4 (44.4%)	
ISS Score	9.00 ± 0.00	9.06 ± 0.38	0.241[1]

***Significant at p<0.05, 1: Wilcoxon-Mann-Whitney U Test, 2: Chi-Squared Test, 3: Fisher's Exact Test

Table 3: Showing Cox Proportional Hazards Regression Coefficients

Variable	*B*	*SE*	CI	*z*	*p*	*HR*
Age>75 Years	1.29	0.35	[0.59, 1.98]	3.64	< .001	3.63
Charlson Index Category 2-3	1.09	0.49	[0.13, 2.06]	2.21	.027	2.98
Charlson_Index Category ≥4	2.34	0.49	[1.37, 3.31]	4.72	< .001	10.34
Injury to_Operation Time 24-48 Hours	-0.39	0.49	[-1.34, 0.56]	-0.81	.421	0.68
aInjury_to Operation Time >48 Hours	1.54	0.42	[0.71, 2.37]	3.65	< .001	4.67
Length of Hospital Stay >4 Days	1.20	0.38	[0.45,1.94]	3.13	.002	3.31
ASA_GradeII	1.01	0.53	[-0.02, 2.05]	1.92	.054	2.76
ASA_GradeIII	1.73	0.50	[0.75, 2.71]	3.46	< .001	5.65
ASA_GradeIV	2.60	0.61	[1.41, 3.79]	4.28	< .001	13.45

Note: Confidence intervals (*CI*) are based on an alpha of 0.05.

Discussion

Though orthopaedic trauma community in last century has been mostly busy in inventing newer modalities and implants for treating hip fractures, last two decades have seen significant research in investigating mortality after these injuries specially in elderly age-group.

In our series, though only 24.1% of our patients had age above 75 years, this group contributed to half of the cases that had mortality. Berry *et al*.reported in a cohort of 195 nursing-home residents aged 65 years and older with hip fractures a 30% increase in mortality with every 5 years of advancing age[12]. A number of other studies showed similar association with increasing age to this adverse outcome, though the incidence varies between different studies [10,13,14].

Majority of the elderly people usually have multiple co-morbidities making them more vulnerable to increased peri-operative complication and it has been found that chance of mortality is doubled in a patient with Charlson score of 4 or more and a body of literature have used CCI to assess risk and predict 1-year mortality[13-16]. Roche *et al*. in their study of 2448 hip fractures found that having 3 or more medical comorbidities was related to higher complication rates and mortality[17].

Bentler*et al*. studied 495 hip fractures and found that patients with 3 or more comorbid conditions were 65% more likely to die than those with fewer conditions[18]. Our mean Charlson score was 1.68 (± 1.54) and 13.8% of the patients were in the Charlson category of 4 or more which gives us quite clear idea that 13.8% of the patients are at more risk of early mortality which is pretty true as the majority in early mortality group is constituted by this category in our study.

In our series, 83.3% of the patients were operated within 48 hours out of which 36.2% of the patient were operated within 24 hours. A prospective study of 850 patients revealed that patients who had surgery within 36 hours of admission experienced shorter hospital LOSs, fewer pressure ulcers, and greater likelihood to return to independent living[19].

Our ultimate goal was to operate the patient as early as possible and reduce the length of hospital stay so that patient can return to prefecture functional level as early as possible without any disability and mortality. In an analysis of 18,209 Medicare recipients who underwent surgery for a hip fracture, a delay in surgery of 2 days or greater from admission was associated with a 17% increase in 30-day mortality[20].

Other studies have not shown a decrease in mortality with surgery within 48 hours of admission[21], but they have revealed decreased minor and major complication rates[22,23].We believe that once the patient is medically optimized, he or she should be taken to surgery in an expeditious manner to prevent potential complication and possibly improve mortality. However, the literature remains mixed in support of this notion.

Systemic review and meta-analysis of 75 studies involving 64,316 patients, overall mortality at 1 month was 13.3%, at 3-6 months was 15.8%, at 1 year was 24.5% and at 2 years was 34.5% and they have identified 12 strong mortality predictors, including advanced age, male gender, nursing home or facility residence, poor preoperative walking capacity, poor activities of daily living, higher ASA grading, poor mental state, multiple comorbidities,dementia or cognitive impairment, diabetes, cancer and cardiac disease. Besides the 12 strong evidence predictors, they identified 7 moderate evidence and 12 limited evidence mortality predictors, only the race was identified as the conflicting evidence predictor[24].Similar results are seen in our study with 1 year mortality of 18.4% and the risk of mortality increases with advancing age, higher Charlson index and ASA grade.

Multiple studies have shown the association between the subject's gender and mortality.

Similar to other studies, we found that men had a higher risk of mortality at 1 year (21%) as compared to female (14.9%). The study byEndo *et al*.of 983 hip fracture patients (206 men) found that men had an increased postoperative complication risk and almost double 1-year mortality, even when controlling for age and health status. In their study, Endo *et al*. found no significant difference in the number of comorbidities between the sexes, but men on average had higher American Society of Anesthesiology scores, suggesting more severe morbidities[25].

The 1-year mortality of a patients treated in a hip fracture program for elders was found to be 21.2% in a study conducted by Schnell *et al*. [26].In our series the overall 1-year mortality was 18.4% which can be further reduced if we had a comprehensive comanaged geriatric hip fracture program.

Our study has its share of limitations in its retrospective nature, relatively small sample size, lack of a control group and hospital-based cohort, data from which may not be applicable to geriatric population in general.

We suggest that, without a dedicated hip-fracture protocol in a resource-poor set-up, early aggressive management to optimize patients for surgery and surgical intervention as soon as feasible lead to early return to pre-fracture status and reduces early mortality.

Conclusion

We suggest that, without a dedicated hip-fracture protocol in a resource-poor set-up, early aggressive management to optimize patients for surgery and surgical intervention as soon as feasible lead to early return to pre-fracture status and reduces early mortality.

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