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Original Research Article

Role of Hip Multidimensional Frailty Score in the Management of Hip Fractures in Elderly Patients

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Abstract:

Introduction: Periarticular hip fractures are common, debilitating injuries in elderly patients, often leading to high mortality rates and prolonged hospitalizations. With a projected increase in hip fractures worldwide, there is an urgent need for accurate preoperative tools to predict postoperative outcomes. The Hip Multidimensional Frailty Score (HMFS), which assesses frailty and physiological reserves, has shown promise in predicting complications in elderly patients with hip fractures. This study aims to validate the predictive value of the HMFS for mortality, postoperative complications, ICU need, and prolonged hospitalization in elderly hip fracture patients.

Materials and Methods: This prospective observational study was conducted at a tertiary care hospital, involving 100 elderly patients (age >60) with hip fractures (neck of femur and intertrochanteric fractures). Preoperative frailty was assessed using the HMFS, along with serum albumin levels. Postoperative outcomes, including ICU admission, complications, hospital stay, and 6-month mortality was studied.

Results: The study revealed a significant association between the HMFS and postoperative outcomes. High HMFS (≥8) was linked to a 30.77% mortality rate, compared to 1.15% in patients with low HMFS (<8) ($p<0.001$). Additionally, 100% of high HMFS patients required ICU care, whereas only 18.4% of low HMFS patients did ($p<0.001$). Prolonged hospitalization (>5 days) was also associated with high HMFS (92.3% vs. 1.15%, $p<0.01$). Preoperative surgical delay (>1 day) was associated with a higher HMFS (mean 6.42 vs. 3.67, $p<0.001$) and increased 6-month mortality (15.8% vs. 2.5%, $p<0.05$). A significant correlation was observed between preoperative delay and 6-month mortality (Odds ratio 3.33, 95% CI 1.6-6.9).

Conclusion: The Hip Multidimensional Frailty Score is a reliable tool for predicting mortality, ICU need, and hospital stay in elderly patients with hip fractures. High HMFS scores correlate with worse postoperative outcomes, including increased mortality and complications, and should be considered in preoperative decision-making. Additionally, reducing preoperative delay may improve outcomes, underscoring the importance of timely surgical intervention.

Keywords: Hip fracture, Frailty score, hip multidimensional frailty score, HMFS, mortality, ICU, postoperative complication, elderly, hospitalisation, ICU.

Introduction

Periarticular hip fractures are a common and morbid injury in elderly patients, with a high mortality rate ranging from 14% to as high as 47%.[1] Surgical intervention is indicated in over 95% cases.[1] The lifetime risk of hip fracture is estimated to be 14% in postmenopausal women and 6% in men, leading to approximately 1.66 million fractures annually worldwide. The incidence of hip fractures increases exponentially with age, and with the global rise in life expectancy, the number of hip fractures is projected to cross six million by 2050.[2,3,4] However, improvements in bone mineral density testing and preventive treatments can lower the incidence.[5] These injuries in the elderly population pose a significant public health concern due to reduced life expectancy and increased hospitalization rates. If the prognosis can be assessed at the time of admission, better resource allocation

could lead to improved outcomes and more efficient postoperative care. Preoperative assessments can predict the need for postoperative intensive care and rehabilitation, allowing for appropriate family counselling regarding expected mortality risk and care needs. Studies have shown that patients with reduced cognitive function, intracapsular fractures, and higher comorbidity are more susceptible to mortality after hip fracture surgery.[6]

Frailty is increasingly recognized as a unique domain of health status, indicating decreased physiological reserves and subsequently, increased vulnerability to fractures in the elderly It can be conceptualized as a global phenotype of physiologic reserves and resistance to stressors.[7]

Although hip surgery can improve mobility and alleviate pain, it is associated with its own set of postoperative complications and risk of mortality. The patients undergoing hip surgery in the aftermath of a fracture are at a higher risk of complications compared to those undergoing elective total hip replacement (THR). This may be attributed to the advanced age and comorbidities of hip fracture patients, as well as physiological processes such as associated acute inflammatory stress, catabolic, and hypercoagulable states.[8]

Surgical decision-making in this population is challenging due to the heterogeneity of health status and the lack of tools for predicting operative risk. Current predictors of postoperative complications have substantial limitations, often focusing on a single organ system or being subjective and failing to estimate a patient's physiological reserves.[9] The interplay of frailty, disability, and comorbidity is widely recognized as a predictor of poor outcomes in elderly hospitalized patients. Previous geriatric assessment markers include older age, cognitive dysfunction, chronic under-nutrition, unexplained falls, depressed mood, and anemia.[10]

Currently, parameters for predicting outcomes in elderly hip fracture patients are assessed individually under separate categories. There is no single, straightforward scoring system that allows clinicians to objectively evaluate and document patient risk, as well as clearly categorize patients. Such a system would also facilitate the comparison of outcomes, including mortality, across different studies.

This study aims to validate the predictive value of the Hip Multidimensional Frailty Score (HMFS) in mortality, postoperative complications, need for intensive care unit (ICU), and prolonged hospital stay in elderly hip fracture patients. Additionally, the association between operative delay, duration of hospitalisation, and multiple other factors with 6-month mortality was also assessed.

Materials and Methods

This was a prospective, observational, cohort study conducted at a tertiary care hospital, involving 100 elderly patients admitted with hip fractures. Data was collected from 100 consecutive elderly patients (Age >60 years) who were admitted with the clinical and radiological (plain radiograph of the pelvis and bilateral hips) diagnosis of proximal femoral fracture and underwent surgical fixation or hemiarthroplasty between November 2022 and October 2023. Sources included the hospital database, inpatient files, and discharge summaries, with incomplete records supplemented by telephone calls and outpatient clinic files. The study included patients over 60 years old admitted for surgical management of fractures around the hip joint, such as neck of femur fractures and intertrochanteric fractures. Excluded were patients under 60 years, those with pathological fractures, and polytrauma patients. Preoperatively, the Hip Multidimensional Frailty Score (Hip-MFS) and serum albumin levels were assessed for all patients. Postoperative data included the need for intensive care, complications, and prolonged hospitalization (defined as hospital stays longer than five days).

Preoperative Assessment and Care: Patients were initially evaluated in the emergency department by an orthopedic doctor, who took a complete history and performed a clinical examination, followed by appropriate radiographs and routine investigations (including serum albumin). The Hip-MFS [6] was assessed preoperatively to categorize patients into high (≥8) and low (<8) scores. Patients and their families were counselled about the procedure, treatment plan, hospital stay duration, potential complications, and the need for ICU care, multiple blood transfusions, and involvement of other specialties. A systemic examination by a general physician and related specialties was conducted for preoperative fitness, and surgeries were scheduled based on physician and anesthetist advice. Demographic data of the patients was collected along with due informed written consent for surgery. The study was approved by the Institutional Ethical Committee and was conducted according to the guidelines of the Declaration of Helsinki.

Surgical Procedure and Postoperative Management: Most surgeries were performed under spinal anesthesia; otherwise, general anesthesia was used. Preoperative delay was counted as the number of days from injury to the surgical intervention. Neck of femur fractures underwent bipolar hemiarthroplasty, while intertrochanteric fractures were treated with open reduction and internal fixation (ORIF) with dynamic hip screw (DHS). Standard positioning and techniques were used for all procedures. High-risk patients were monitored in the ICU postoperatively before being shifted to the ward upon clearance from related specialties. Appropriate antibiotics were administered, and pain was managed

using opioids like Tramadol and NSAIDs. Blood hemoglobin levels were checked on the first post-operative day, and patients received deep vein thrombosis prophylaxis if high risk. Oral medication was started as tolerated.

For DHS patients, surgical site dressings were changed on the second day, and wheelchair mobilization, along with active and assisted range of motion exercises, began. Hemiarthroplasty patients started weight-bearing as tolerated with a walker and undertook ankle and knee mobilization exercises. All patients were given antibiotics, analgesics, oral deep vein thrombosis prophylaxis, and other medications as per their comorbidities upon discharge. Monthly outpatient department reviews continued for six months. Pre-injury and post-surgery morbidity and mortality data were collected through telephonic interviews with patients' relatives and hospital death summaries.

Statistical Analysis

The Hip-MFS, introduced by Choi et al. [6], assesses postoperative mortality rates in elderly patients with proximal femur fractures. This composite score, ranging from 0 to 14, includes eight domains: sex, Charlson Comorbidity Index, serum albumin, Koval grade, mid-arm circumference, dementia, risk of falling, and mini nutritional assessment. A score above 8 indicates high risk. This study utilizes the original Hip-MFS parameters to evaluate their role in managing hip fractures in Indian elderly patients, marking the first application of this composite score in this population. [6]

Data analysis was performed using SPSS version 22.0, with the assistance of a qualified statistician. The analysis included calculating ranges, frequencies, and percentages for qualitative variables, and means and standard deviations for quantitative variables. The significance of differences between quantitative variables was tested using Student's unpaired't' test and ANOVA test, while qualitative variables were analyzed using Yate's and Fisher's chi-square tests. A p-value of less than 0.05 was considered statistically significant.

Results

The demographic distribution of the study population was as is summarized in Table 1. Mean serum albumin levels were 4.06+/-0.04. The number of patients with hypoalbuminemia (albumin level < 3.5) was 8 (8%) with 1 mortality in 6 months (12.5%) and 92 patients with normal albumin level had 4 mortality in 6 months (4.3%) denoting no significant association (p=0.31). The patient's walking dependency was categorized as independence (Koval grade 1) Limited independence (Koval grade 2-6) and unable to walk (Koval grade 7) and were assigned to score 0, 1, and 2 respectively. In the current study 63 patients had a score of 0, with 1 mortality (1.6%), 33 patients had a score 1, with 1 mortality (3%), and 4 patients had a score of 2 with 3 mortalities (75%).

Table 1: Demographic distribution of sample population.

	Demographic variable	Distribution	Number	Percentage
1.	**Age (in years)**	**60-70**	45	45%
		71-80	28	28%
		81-90	22	22%
		91-100	5	5%
2.	**Sex**	**Male**	47	47%
		Female	53	53%
3.	**Fracture morphology**	**Intertrochanteric**	46	46%
		Neck of Femur	54	54%
4.	**Comorbidities**	**Hypertension**	43	43%
		Diabetes Mellitus	45	45%
		Ischemic Heart Disease	19	19%
		Cerebrovascular Accident	5	5%
5.	**Number of comorbidities**	**No co-morbidity**	25	25%
		1-2 co-morbidity	71	71%
		>2 co-morbidity	4	4%
6.	**Koval grading**	**0**	63	63%
		1	33	33%
		2	4	4%
7.	**Preoperative cognitive status**	**Normal**	68	68%
		Mild Impairment	31	31%
		Dementia	1	1%
8.	**Mini nutritional assessment**	**Normal**	70	70%
		Risk of Malnutrition	28	28%
		Malnutrition	3	3%

9.	**Mid-arm circumference**	**< 24.6**	22	22%
		24.6 – 27	19	19%
		> 27	59	59%

Low HMFS (<8) was seen in 87 patients and high HMFS (≥8) was seen in 13 patients. Statistically significant association (p<0.001) was found between mortality and HMFS with the mortality rate between high HMFS and low HMFS being 30.77% (4/13) and 1.15% (1.87) respectively. Similarly, 100% of high HMFS patients (13/13) required postoperative ICU care, as compared to 18.4% (16/87) of low HMFS patients, suggesting significant association (p<0.001). Out of 100, 13 (13%) patients had a hospital stay of more than 5 days. Out of these 13 patients, 12 patients (92.3%) had a high HMFS meanwhile only 1 (1.15%) had a low HMFS. This showed a significant association between HMFS and longer hospital stay (p<0.01) (Table 2). The median and interquartile range of duration of hospital stay between low vs high Hip-MFS were 4 vs 7 and (4,5) vs (6,8) respectively.

Table 2: Distribution of hip multidimensional frailty score (HMFS) with various variables

Serial number	Variable		Distribution	HMFS		Total
				Low	High	
1.	**6-month mortality**	No	Count	86	9	95
			% of Total	86%	9%	95%
		Yes	Count	1	4	5
			% of Total	1%	4%	5%
		Count		87	13	100
		% of mortality		1.15%	30.77%	-
2.	**ICU care**	No	Count	71	0	71
			% of Total	71%	0.0%	71%
		Yes	Count	16	13	29
			% of Total	16%	13%	29%
		Count		87	13	100
		% of Total		18.4%	100%	100.0%
3.	**Longer hospital stay**	No	Count	86	1	87
			% of Total	86%	1%	87%
		Yes	Count	1	12	13
			% of Total	1%	12%	13%
		Count		87	13	100
		% with longer hospital stay		1.15%	92.3%	

Average delay in time since injury to surgery in current study was 1.32 days. The patients were divided into two groups: Patients operated within one day (n_o=81) and more than one day of delay (n_d=19). The mean HMFS for patients operated within a day was 3.67 as compared to 6.42 in the delayed more than one day group.

The association between pre-operative delay and HMFS as per Mann Whitney U test was significant (p < 0.001). Similarly, percentage mortality at 6 months from surgery was higher in delayed intervention group (3/19;15.8%) as compared to their counterparts (2/81; 2.5%) denoting a significant association between pre-operative delay and 6-months mortality too (p<0.05). The Odd's ratio for preoperative delay was 3.33 with 95% confidence interval (1.6-6.9). Using the logistic regression analysis of the combined effect of covariates on Hip MFS, preoperative delay showed significant correlation. The count and percentage of patients with longer hospital stay having post-operative complications (eg pneumonia, urinary tract infection, delirium, acute pulmonary thromboembolism, etc) was 13 (13%).

Discussion

This study confirmed that hip multidimensional frailty score in patients with hip fracture undergoing fixation or arthroplasty has a good predictive value for postoperative complications, duration of hospitalization, prolonged hospital stay, and 6-month mortality in elderly population. This is of significance owing to the high burden of these injuries in elderly patients and the associated mortality levels. Hence, using HMFS for these patients can help in better preemptive and proper follow-up care of these patients, and counselling the patients and families regarding potential outcomes. The demographic distribution of the sample population of this study was similar to the studies by Karademir et al [11], and Holt et al [1].

High HMFS had a significant association with 6-months postoperative mortality (30.77% vs 1.15%) which was higher than that reported by Choi et al [6] who reported 18.8% mortality in high and 3.6%

mortality in low HMFS score patients. High MFS scores were also associated with longer duration of stay (92.3% vs 1.15%) similar to Kim et al [12]. Choi et al [6] in their study also reported prolonged hospital stay among high HMFS patients (29.9%) compared to low HMFS patients (19.2%). Need for ICU care in patients with high HMFS was higher (13/13,100%) as against those with low HMFS (16/87,18.4%). These findings were similar to Kim et al. [12] High HMFS also resulted in more delay from injury to surgery as optimum stabilisation of the patient to preclude perioperative mortality took longer, an association which to the best of our knowledge has not been reported yet in the literature.

Advanced age has been reported to be an independent risk factor for mortality after proximal femur fractures in studies by Karademir et al [11], Choi et al [6], and Holt et al [1]. Although this was not separately assessed in this study, the numbers were similar (Table 3). Similarly, female patients were found to have less 6-month mortality than males, which corroborated the findings of Holt et al [1] (Male: Female::25%:16%) and Choi et al [6] (Male: Female::11.2%:6.9%). Among the sample population of the study, 25 patients had no comorbidity, 71 had 1-2 co-morbidities, and 4 patients had more than 2 comorbidities. The mortality rate associated with number of comorbidities in this study (4% (3/71) in patients with 1-2 comorbidities and 50% (2/4) in patients with more than 2 comorbidities) was similar to the numbers published by Charlson et al [13] who also reported just over 50% mortality in patients with more than 2 comorbidities. Choi et al [6] also reported a higher Charlson co-morbidity index to be associated with increased 6-month mortality (Table 3).

Yoon et al [14] in their study reported 15 patients as Koval grade 0, 39 patients classified as Koval grade 1 and 2 patients as Koval grade 2. They showed that a higher Koval grade indicates a higher HMFS score assigned to the patient, which in turn increases the risk of mortality. These findings were similar to this study wherein 75% mortality was seen in Koval grade 2 as compared to 3% and 1.6% in grade 1 and 0 respectively (Table 3). Although the hypoalbuminemia rate in this study was lower than that of Choi et al [6] and Lauland et al[15] , the mortality rate in patients with low albumin levels was higher than those with normal levels as published in the aforementioned studies (Table 3). The average time from injury to surgery (in days) in this study was lower than that of Choi et al [6] (1.32 vs 4.08). The delay to surgery showed significant association with 6-month mortality rate in this study and although not reported widely, Holt et al [1] in 2008 in their study found that time from fracture to surgery and time from fracture to hospitalisation affected the 30 days mortality but not 120 days mortality (Table 3). Post-operative complications were seen in 13% of patients in our study compared to 38% in that of Choi et al [6] and 10.5% in Kim et al [12].

Table 3: Comparison of study findings with other studies

Serial number	Variable	Previous study results	Current study results
1.	**Age**	**Karademir et al [11] (2015)** >85years – increased mortality. **Holt et al [1](2008)** 120-day mortality rate: >90years -28%, 50- 59 years- 5%.	6-month mortality rate 60-70 years -0 (0%), 71-80 years-0 (0%), 81-90 years- 2 (9.1%), 90-100 years-3 (60%).
2.	**Sex**	**Holt et al [1] (2008)** 6-month mortality rate: Males- 25%, Females- 16% **Choi et al [6] (2017)** 6-month mortality rate: Males - 11.2% Females -6.9%.	6-month mortality rate Males-6.38% Females-3.77%
3.	**Comorbidities**	**Charlson et al [13] (1987)** Mortality rate: 0 comorbidities- 12% 1-2 co-morbidities- 26% >2 co-morbidities- 52%.	6-month mortality rate 0 comorbidities – 0% 1-2 comorbidities- 4% > 2 comorbidities- 50%.
4.	**Koval grading**	**Yoon et al [14] (2013)** Distribution : Grade 0-15 patients Grade 1-39 patients Grade 2-2 patients.	Distribution (% mortality) Grade 0– 63 patients (1.6%) Grade 1– 33 patients (3%) Grade 2– 4 patients (75%)

5.	**Serum Albumin (Hypoalbuminemia <3.5 g/dl)**	**Lauland et al [15] (2012)** Hypoalbuminemia-44% Low albumin, low albumin with high Total Leukocyte Count (TLC), & low albumin with low TLC, all had high mortality rate. **Choi et al [6] (2017)** Low Albumin level is associated with higher 6-month postoperative mortality.	Distribution (% mortality) Hypoalbuminemia– 8 patients (1 death, 12.5%) Normal albumin- 92 patients (4 deaths, 4.3%)
6.	**Time from injury to surgery**	**Holt et al [1] (2008)** Time from fracture to surgery and time from fracture to hospitalisation affected the 30 days mortality but not the 120 days mortality. **Choi et al [6] (2017)** Average preoperative delay was 4.08 days.	Distribution (% mortality) Pre-operative delay <1 day– 81 patients (2 deaths, 2.5%) Pre-operative delay >1 day- 19 patients (3 deaths, 15.8%)

This study was not without limitations. The geographical area for collection of samples was limited. The sample size could have been larger and the follow-up period could have been longer. The entire study was performed at a single tertiary care university hospital.

Postoperative outcomes are variable and influenced by the skill of surgeons and the quality of the medical team; therefore, this scoring system might not be generalizable to other settings and needs to be validated in a larger population and across multiple institutions. As collection of data involved using information from telephonic interviews, recall bias could be associated. Additionally, the complications were not evaluated in terms of severity. However, the study holds value in its comprehensive association analysis of HMFS with multiple independent risk factors and being one of the first studies to assess its relation with delay from injury to surgery.

In conclusion, Hip Multidimensional Frailty Score is an excellent predictive tool for mortality, postoperative complication, need for ICU care, and prolonged hospitalization in elderly patients with proximal hip fractures undergoing surgical fixation or hemiarthroplasty. Additionally, operative delay, and duration of hospitalization were also associated with high 6-month mortality. Hence, preoperative assessment of HMFS is advised in all cases of elderly proximal femur fractures to predict the need for better preemptive and proper follow-up care of these patients, and counselling the patients and families regarding potential outcomes.

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