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Development and Validation of a Morbidity and Mortality Prediction Score for Proximal Femur Fracture Patients with Comorbidities

Dr. Yash Ratanpal[1], Dr. Ravindra B. Gunaki[2]

[1]Department of Orthopaedics, Krishna Institute of Medical Sciences, Krishna Vishwa Vidyapeeth, "Deemed To Be University", Karad, Malkapur, Karad (Dist. Satara), Maharashtra, India. PIN – 415539.
yashratanpal89@gmail.com

[2]Professor, Department of Orthopaedics, Krishna Institute of Medical Sciences, Krishna Vishwa Vidyapeeth, "Deemed To Be University", Karad, Malkapur, Karad (Dist. Satara), Maharashtra, India. PIN – 415539.
rbgunki@gmail.com

KEYWORDS

proximal femur fractures, comorbidity index, elderly patients, postoperative complications, mortality, risk assessment, dementia, ischemic heart disease, renal disease, survival analysis.

ABSTRACT

Proximal femur fractures in elderly patients are associated with high morbidity and mortality, primarily due to the presence of multiple comorbidities and adverse lifestyle factors. This study aimed to develop and validate a comorbidity index to assess the risk of postoperative complications and mortality in elderly patients undergoing surgery for proximal femur fractures. A mixed-methods approach was used, combining both prospective and retrospective data from 100 patients, each followed at various intervals post-surgery (immediate, 3 months, 6 months, and 1 year). The comorbidity index included key predictors such as age, pre-fracture mobility, anemia, diabetes mellitus, hypertension, ischemic heart disease, renal disease, dementia, alcohol dependence, and tobacco use. Statistical analysis revealed that higher comorbidity scores were significantly correlated with increased mortality and complications, with dementia, ischemic heart disease, and renal disease showing the strongest associations. Kaplan-Meier survival analysis confirmed that patients with comorbidity scores above 10 had markedly lower survival rates over one year. The comorbidity index proves to be a valuable tool for preoperative risk stratification, enabling tailored, multidisciplinary care that can improve postoperative outcomes for high-risk patients. Future research should focus on further validating this index and investigating targeted interventions for patients with elevated comorbidity burdens.

Introduction

Proximal femur fractures, particularly intertrochanteric and subtrochanteric fractures, are a prevalent and severe health issue among the elderly population. These fractures often occur as a result of low-energy trauma, typically from a simple fall from a standing height, and are strongly associated with age-related bone density loss and frailty. Due to the high prevalence of chronic conditions in older adults, these fractures not only disrupt physical health but also lead to increased morbidity and mortality, presenting a significant challenge to healthcare systems globally. As populations age worldwide, the incidence of proximal femur fractures is expected to rise, making it imperative to understand the multifaceted factors that influence the outcomes of these injuries, particularly the role of patient comorbidities.

A. Proximal Femur Fractures and Their Relevance in the Elderly Population

The proximal femur is crucial in weight-bearing and stability, and fractures in this region can severely impair mobility and independence. With advancing age, the risk of proximal femur fractures increases substantially due to factors like reduced bone mineral density (osteoporosis), muscle weakening (sarcopenia), and impaired balance. Elderly individuals often suffer from osteopenia or osteoporosis, conditions that weaken the bones and make them more susceptible to fractures even from minor falls. The anatomical structure of the proximal femur—specifically, the femoral neck and intertrochanteric region—also contributes to its susceptibility to fracture. These fractures lead to immediate functional limitations, and many patients face prolonged periods of immobility, which can lead to secondary complications.

The prevalence of proximal femur fractures among the elderly is a substantial public health concern, with estimates indicating that the lifetime risk of hip fracture is 17.5% in women and 6% in men. These fractures are particularly costly to treat due to the high rate of postoperative complications, extended hospital stays, and the need for rehabilitation or long-term care. Moreover, a large portion of elderly patients with these fractures do not return to their pre-fracture level

of function, contributing to a decreased quality of life and increased dependency on caregivers.

B. Morbidity and Mortality in Proximal Femur Fractures

Proximal femur fractures in elderly patients are associated with significant morbidity and mortality. The mortality rate for these patients is notably high, with estimates showing that approximately 20-30% of patients die within one year post-fracture. The initial weeks following the fracture represent a critical period, with the highest risk of complications and death. Studies have shown that mortality rates are particularly elevated in the first three months post-injury, with a gradual decline afterward, though risks remain elevated compared to the general elderly population. This elevated risk of mortality in elderly patients can be attributed to various factors, including the physiological stress of surgery, prolonged immobility, and pre-existing comorbidities.

Morbidity in these cases is often compounded by the prolonged hospital stays and rehabilitation periods required for recovery. Patients may experience a range of postoperative complications, including deep vein thrombosis, pneumonia, urinary tract infections, and pressure sores, all of which are associated with extended periods of immobility. Moreover, the psychological impact of a femur fracture—often involving fear of falling again, depression, and loss of independence—can further affect recovery and overall well-being. Many elderly patients are unable to regain their previous level of physical function, leading to a reliance on assistive devices or permanent mobility limitations. Consequently, the recovery process following a proximal femur fracture in the elderly is often challenging, prolonged, and rarely leads to a full return to pre-fracture functioning.

C. Impact of Comorbidities on Outcomes

In addition to the immediate physical consequences of a proximal femur fracture, the presence of comorbidities has a profound impact on the morbidity and mortality of affected patients. Older adults frequently suffer from a range of chronic conditions such as diabetes mellitus, hypertension, coronary artery disease, chronic kidney disease, and cognitive impairments. Each of these conditions can complicate the management of proximal femur fractures and reduce the likelihood of a successful outcome.

1. Diabetes Mellitus. Diabetes mellitus, a common condition among elderly patients, can negatively affect wound healing, increase the risk of infection, and contribute to poor surgical outcomes. Chronic hyperglycemia impairs immune function, making diabetic patients more susceptible to infections following surgery. Additionally, diabetes-related microvascular complications can interfere with bone healing, prolonging recovery time and increasing the risk of fracture non-union.

2. Hypertension. Hypertension, prevalent among the elderly, is a major risk factor for perioperative cardiovascular complications such as myocardial infarction and stroke. This condition can exacerbate the physiological stress of surgery, leading to poor outcomes. High blood pressure can impair tissue perfusion, delay wound healing, and increase the likelihood of infection, all of which are critical to postoperative recovery.

3. Coronary Artery Disease. Patients with coronary artery disease are at an increased risk of cardiovascular events during and after surgery for femur fractures. The stress of surgery can trigger adverse cardiovascular responses, leading to complications such as arrhythmias, heart failure, and myocardial infarction. Managing these risks is challenging and requires a multidisciplinary approach to optimize cardiac function and minimize perioperative complications.

4. Chronic Kidney Disease (CKD). Chronic kidney disease is associated with an increased risk of perioperative complications due to impaired renal function, electrolyte imbalances, and reduced drug clearance. CKD patients are more likely to experience adverse drug reactions, infections, and cardiovascular events, all of which can complicate the recovery from femur fracture surgery.

5. Cognitive Impairment. Cognitive impairments, including dementia, are common among the elderly and can complicate postoperative care. Patients with cognitive deficits may have difficulty adhering to rehabilitation protocols and are at a higher risk of postoperative delirium, a condition associated with increased mortality and prolonged hospital stays. Cognitive impairment also complicates pain management, as patients may struggle to communicate discomfort effectively, leading to suboptimal pain control.

6. Lifestyle Factors. Lifestyle factors, such as alcohol dependence and tobacco use, also significantly impact morbidity and mortality outcomes. Chronic alcohol use can interfere with the metabolism of anesthetic agents, increase the risk of infection, and impair wound healing. Tobacco use is linked to cardiovascular disease and delayed wound healing, both of which pose serious risks to postoperative recovery in elderly patients with proximal femur fractures.

Proximal femur fractures represent a complex and significant health challenge in elderly patients due to the interplay between injury, comorbidities, and advanced age. Managing these fractures requires a comprehensive, multidisciplinary approach that addresses not only the surgical repair but also the underlying chronic conditions that can complicate recovery. Understanding the impact of comorbidities on morbidity and mortality is essential for improving clinical outcomes and developing strategies to

minimize risks for this vulnerable population. Given the expected rise in proximal femur fractures among aging populations, further research is warranted to enhance predictive models, optimize preoperative management, and refine postoperative care protocols tailored to patients with comorbidities.

I. Literature Review

The prognosis for elderly patients with proximal femur fractures is often complicated by the presence of comorbidities and lifestyle factors, which have been shown to significantly influence morbidity and mortality rates. This section reviews key studies that examine the impact of common comorbidities, such as diabetes mellitus, hypertension, ischemic heart disease, and renal disease, as well as lifestyle factors like alcohol dependence and tobacco use, on outcomes following femur fracture surgery. These findings underscore the need for tailored, multidisciplinary management strategies for this vulnerable patient population.

Diabetes mellitus is one of the most common comorbid conditions in elderly patients and is well-documented as a risk factor for adverse surgical outcomes. Studies indicate that diabetic patients who undergo surgery for proximal femur fractures face increased risks of postoperative complications, delayed healing, and heightened mortality rates. Chronic hyperglycemia impairs immune function and hinders wound healing, which can lead to infections and extended hospital stays. A systematic review by Thakar et al. (2016) found that diabetic patients with hip fractures had a 20-30% higher risk of postoperative complications, particularly infections, compared to non-diabetic patients . Elevated blood glucose levels contribute to oxidative stress and inflammation, which can damage blood vessels, nerves, and tissues, exacerbating the recovery process and increasing the likelihood of non-union or delayed union in fractures.

Another study by Zhou et al. (2020) specifically highlighted that diabetic patients experienced higher one-year mortality rates post-surgery than their non-diabetic counterparts (25% versus 15%) . Furthermore, a large retrospective study by Grosso et al. (2019) on 500 patients with intertrochanteric fractures found that diabetic patients exhibited a 30% higher risk of surgical site infections and delayed fracture healing compared to non-diabetic patients. These findings support the need for careful glycemic control in diabetic patients undergoing hip fracture surgery, as improved blood sugar regulation before and after surgery has been associated with reduced complication rates and improved recovery .

Hypertension, another prevalent condition in elderly populations, is associated with increased risks of cardiovascular complications during and after surgery for proximal femur fractures. Increased blood pressure can lead to perioperative myocardial infarction, heart failure, and arrhythmias, complicating the recovery process. Liu et al. (2017) demonstrated that uncontrolled hypertension was linked to a 40% increase in postoperative morbidity, primarily due to cardiovascular events, compared to patients with well-managed hypertension . Similarly, a study by Khan et al. (2018) on 300 hypertensive patients undergoing femur fracture surgery found a 20% increase in cardiovascular complications, such as stroke and myocardial infarction, among patients with uncontrolled hypertension . These patients also experienced prolonged recovery times and higher incidences of acute kidney injury due to compromised microcirculation and impaired tissue perfusion.

The findings highlight the importance of preoperative blood pressure control to minimize perioperative complications in hypertensive patients. Effective blood pressure management, including perioperative monitoring and possible pharmacologic adjustments, can significantly lower the risk of adverse events, as well-managed hypertensive patients show similar recovery rates to those without hypertension.

Patients with ischemic heart disease (IHD) are at an elevated risk of perioperative cardiovascular events due to their compromised cardiac function, particularly during the physiological stress of surgery. Studies have shown that the risk of myocardial infarction and heart failure is considerably higher in patients with IHD who undergo femur fracture surgery. Research by van Diepen et al. (2015) demonstrated that IHD patients had a 35% increased risk of perioperative cardiovascular events and a higher one-year mortality rate compared to non-IHD patients . Further support comes from the American Heart Association (AHA), which recommends thorough cardiovascular evaluation and risk stratification for IHD patients undergoing non-cardiac surgeries such as hip fracture repair .

Patients with IHD often require multidisciplinary preoperative and postoperative management, including stress testing, beta-blockers, and antiplatelet therapy. In a study by Green et al. (2019), IHD patients not only had longer postoperative recovery periods but also higher rates of reoperation due to complications such as implant failure and fracture non-union . Addressing these cardiovascular risks through comprehensive evaluation and management can reduce the likelihood of adverse outcomes in IHD patients undergoing femur fracture surgery.

Renal disease, particularly chronic kidney disease (CKD), complicates the perioperative management of elderly patients due to impaired renal function, which affects fluid and electrolyte balance and drug metabolism. A study by Lin et al. (2019) found that CKD patients had a significantly higher risk of postoperative complications, including acute kidney injury, cardiovascular events, and infections . The metabolic and systemic imbalances caused by impaired kidney function contribute to increased

morbidity and mortality in CKD patients following femur fracture surgery. The National Kidney Foundation recommends careful hydration management, avoidance of nephrotoxic drugs, and close monitoring of renal function as essential perioperative strategies to reduce these risks.

Lifestyle factors such as alcohol dependence and tobacco use have a substantial impact on postoperative recovery and mortality in elderly patients undergoing surgery for proximal femur fractures. Chronic alcohol use is associated with poor wound healing, immunosuppression, and increased risk of infection. According to a study by Ooi et al. (2018), patients with alcohol dependence had significantly higher rates of postoperative complications and mortality following femur fracture surgery . Alcohol use disrupts the metabolism of anesthetic agents and medications, necessitating additional perioperative management considerations.

Moreover, tobacco use, particularly smoking and tobacco chewing, has been shown to impair wound healing and increase perioperative risks. The nicotine and other harmful substances in tobacco negatively affect cardiovascular health, increasing the likelihood of postoperative complications, such as infections and cardiovascular events. A study by Singh et al. (2017) found that tobacco users undergoing femur fracture surgery experienced a 25% higher rate of postoperative complications and prolonged hospital stays compared to non-users . In response to these findings, healthcare providers often recommend smoking cessation programs before surgery to enhance recovery outcomes and reduce the risk of complications.

Patients with multiple comorbidities face a compounded risk of poor outcomes after femur fracture surgery. Martin et al. (2021) conducted a study on 1,000 patients with various combinations of comorbidities, revealing that those with two or more conditions had a 40% higher risk of postoperative complications and a 35% increase in one-year mortality compared to patients with a single comorbidity . Williams et al. (2022) also reported that patients with combined diabetes, hypertension, and ischemic heart disease exhibited the highest rates of complications, including infections, cardiovascular events, and reoperation rates, with the highest observed mortality rates at six months and one year . These studies highlight the importance of a comprehensive, multidisciplinary approach to managing patients with multiple comorbidities.

The literature consistently emphasizes that comorbid conditions and lifestyle factors substantially impact morbidity and mortality rates in elderly patients undergoing surgery for proximal femur fractures. Conditions such as diabetes, hypertension, ischemic heart disease, and chronic kidney disease complicate postoperative recovery, increasing the risk of adverse outcomes. Similarly, lifestyle factors, including alcohol and tobacco use, pose significant risks to surgical success and recovery. The evidence suggests that a comprehensive, individualized approach to perioperative management is critical for improving outcomes in this vulnerable population. Future studies should focus on refining predictive models that consider these comorbidities and lifestyle factors to optimize perioperative strategies and improve long-term survival and quality of life for elderly patients with proximal femur fractures.

II. Materials and Methods

This study aimed to investigate the impact of comorbidities and lifestyle factors on postoperative morbidity and mortality in elderly patients with proximal femur fractures. Conducted as a mixed-methods study, it incorporated both prospective and retrospective data collection approaches to enhance the robustness and validity of the findings. This section provides a detailed description of the study design, inclusion and exclusion criteria, data collection procedures, and statistical analysis methods.

A. Study Design

This study followed a mixed-methods approach, combining both prospective and retrospective analyses to obtain a comprehensive dataset. The prospective analysis involved tracking patients with newly diagnosed proximal femur fractures over a one-year period, allowing the research team to monitor their recovery and any postoperative complications in real-time. In parallel, a retrospective analysis was conducted on a cohort of patients who had previously undergone surgery for proximal femur fractures and met the study's inclusion criteria. This dual approach facilitated the examination of outcomes over a broad time span, as well as the comparison of prospective and retrospective results, thus increasing the validity of the study findings.

B. Prospective Analysis

In the prospective arm of the study, patients with proximal femur fractures who were admitted to the orthopedics department were enrolled and followed up for one year. Data were collected at regular intervals to monitor postoperative outcomes, with particular focus on comorbidities, lifestyle factors, and any complications that arose. The aim of the prospective component was to observe the progression of postoperative recovery in real-time and to provide an accurate record of the impact of comorbidities and lifestyle factors on mortality and morbidity rates.

C. Retrospective Analysis

The retrospective analysis involved a review of medical records from patients who had previously been treated for proximal femur fractures at the study site. Patients who met the inclusion criteria were identified and their medical records were examined to extract relevant data, including information on comorbidities, lifestyle factors, and postoperative outcomes. This historical

data provided a valuable baseline for comparison with the prospective cohort, enabling the research team to assess any changes in outcomes and trends over time.

D. Inclusion and Exclusion Criteria

The study applied strict inclusion and exclusion criteria to ensure that the sample population was representative of elderly patients at high risk for complications associated with proximal femur fractures. The criteria were defined as follows:

i. Inclusion Criteria

1. Diagnosis of Proximal Femur Fracture: Patients included in the study were required to have a confirmed diagnosis of a proximal femur fracture, either intertrochanteric or subtrochanteric, confirmed through clinical assessment and radiographic imaging.

2. Age 50 Years or Older: Given the focus on the elderly population, only patients aged 50 years and above were considered eligible for the study. This criterion reflects the higher prevalence of proximal femur fractures and associated comorbidities in older age groups.

3. Presence of Comorbidities: The study was specifically interested in patients with comorbid conditions such as diabetes, hypertension, ischemic heart disease, chronic kidney disease, and cognitive impairment, as these factors are known to influence postoperative outcomes.

4. Informed Consent for Prospective Cohort: For patients in the prospective cohort, informed consent was obtained prior to enrollment. This ensured that patients understood the purpose of the study and agreed to participate in follow-up assessments over the one-year period.

ii. Exclusion Criteria

1. Pathological Fractures: Patients with fractures resulting from pathological conditions, such as metastatic cancer, were excluded due to the unique nature and treatment requirements of these fractures, which differ significantly from fractures caused by low-energy trauma in elderly patients.

2. Periprosthetic Fractures: Patients with fractures around existing orthopedic implants, such as those from previous hip or femur surgeries, were excluded, as these cases often involve unique surgical and recovery protocols.

3. Non-Surgical Treatment: Only patients who had undergone surgical intervention for their proximal femur fracture were included. Those managed conservatively without surgery were excluded, as their recovery trajectory and associated risks differ from surgically treated patients.

4. Previous Hip or Femur Fractures: Patients with a history of prior fractures in the hip or femur were excluded, as their outcomes may be influenced by previous surgical interventions and recovery patterns that could confound the results.

E. Data Collection Methods

Data collection involved gathering both clinical and demographic information from each patient in the study. The data were sourced from patient interviews, medical records, laboratory results, and imaging studies. Key data points included demographic information, comorbidities, lifestyle factors, pre-fracture mobility, and detailed postoperative outcomes. Data were collected at four primary time points for the prospective cohort: preoperatively, three months postoperatively, six months postoperatively, and one year postoperatively.

F. Comorbidities and Lifestyle Factors

The study focused on several common comorbidities and lifestyle factors associated with postoperative morbidity and mortality. The comorbidities included diabetes mellitus, hypertension, ischemic heart disease, chronic kidney disease, dementia, and a history of stroke. Lifestyle factors, such as alcohol dependence and tobacco use, were also recorded, as these are known to impact wound healing and increase postoperative complication risks. Each comorbidity and lifestyle factor was scored based on severity, duration, and treatment status, contributing to an overall comorbidity index for each patient.

i. Outcome Measures

Postoperative outcomes included mortality rates at various time points, as well as the incidence of specific complications, such as infections, cardiovascular events, and thromboembolic complications. Functional outcomes, including mobility, independence, and quality of life, were also evaluated through patient interviews and clinical assessments.

ii. Statistical Analysis

The data analysis aimed to identify statistical associations between comorbidities, lifestyle factors, and postoperative outcomes. A comorbidity index score was calculated for each patient based on the presence and severity of individual comorbidities, allowing for stratification of patients into risk categories.

iii. Descriptive Analysis

Descriptive statistics, including means, medians, and standard deviations, were used to summarize the demographic and clinical characteristics of the study population. Frequencies and percentages were calculated for categorical variables, such as gender distribution, comorbidity prevalence, and mortality rates.

G. Comparative Analysis

Comparative analyses were conducted between patients with high comorbidity index scores and those with low scores. Chi-square tests were employed to

assess differences in categorical variables, such as mortality rates and complication rates, between these two groups. Continuous variables, such as age and comorbidity scores, were analyzed using t-tests or Mann-Whitney U tests, depending on the data distribution.

iii. Survival Analysis

Kaplan-Meier survival curves were generated to compare the survival rates of patients with different comorbidity index scores. The log-rank test was used to assess the statistical significance of differences in survival rates between high-risk and low-risk patients. This analysis allowed the research team to visualize the impact of comorbidity burden on long-term survival following proximal femur fracture surgery.

iv. Regression Analysis

Multivariate Cox proportional hazards regression models were employed to determine the independent effects of each comorbidity and lifestyle factor on mortality risk. The regression models adjusted for potential confounding factors, such as age, gender, and pre-fracture mobility. Hazard ratios (HRs) and 95% confidence intervals (CIs) were reported for each variable, providing insights into the relative impact of individual risk factors on postoperative mortality.

v. Statistical Software

All statistical analyses were performed using SPSS version 26.0 (IBM Corporation) and R version 4.0.2 (R Foundation for Statistical Computing). A p-value of less than 0.05 was considered statistically significant for all analyses, indicating that the observed results were unlikely to be due to random chance.

The study protocol was reviewed and approved by the institutional ethics committee, ensuring that it met all ethical standards for research involving human participants. Informed consent was obtained from all patients enrolled in the prospective component of the study, and patient anonymity was preserved throughout the research process. The retrospective analysis was conducted in compliance with relevant guidelines, and patient data were anonymized to maintain confidentiality.

By combining prospective and retrospective approaches, this study's design offers a comprehensive view of the impact of comorbidities and lifestyle factors on morbidity and mortality in elderly patients with proximal femur fractures. The inclusion and exclusion criteria ensured a focused and representative sample, while the detailed data collection and robust statistical analysis provided valuable insights into the factors influencing postoperative outcomes. This study design lays the groundwork for developing evidence-based strategies to improve the management and prognosis of patients with complex comorbid profiles undergoing surgery for proximal femur fractures.

III. Comorbidity Index Development

The comorbidity index developed for this study is a scoring tool designed to assess the impact of various health conditions and lifestyle factors on the morbidity and mortality outcomes of elderly patients undergoing surgery for proximal femur fractures. By quantifying the severity and prevalence of specific comorbidities and risk factors, the index serves as a predictive model to identify patients at high risk for postoperative complications and mortality. Each factor included in the index was carefully selected based on its established role in influencing surgical outcomes, and a weighted scoring system was developed to reflect the relative impact of each predictor on patient prognosis.

Selection of Predictors

The predictors chosen for the comorbidity index encompass a range of physiological, chronic health, and lifestyle factors commonly observed in elderly patients. These predictors include age, pre-fracture mobility, anemia, diabetes mellitus, hypertension, ischemic heart disease, renal disease, dementia, alcohol dependence, tobacco use, serum protein levels, previous surgeries, history of stroke, antiplatelet drug use, and the time from operation to death. Each predictor is justified based on its well-documented influence on postoperative recovery and its relevance to the study population.

1. Age

Age is a critical predictor of surgical outcomes, with older age being directly associated with higher mortality and morbidity rates in patients with femur fractures. Age impacts bone density, muscle mass, immune response, and overall resilience, making it an essential factor in the index. Scores increase progressively with age, reflecting the compounding effects of aging on surgical recovery.

2. Pre-Fracture Mobility

Pre-fracture mobility assesses the patient's level of independence before the injury, as those with reduced mobility are at a higher risk of postoperative complications due to weaker musculoskeletal and cardiovascular systems. Patients with limited pre-fracture mobility also face a higher likelihood of prolonged immobility post-surgery, contributing to complications such as pressure ulcers and infections.

3. Anemia

Anemia reduces the blood's oxygen-carrying capacity, which can impair wound healing and exacerbate cardiovascular strain during surgery. Anemia is associated with tissue hypoxia, which can prolong recovery and increase the risk of postoperative complications. Patients with moderate to severe anemia were assigned higher scores to capture the risk associated with impaired oxygen delivery to tissues during and after surgery.

4. Diabetes Mellitus

Diabetes is associated with poor wound healing, increased infection rates, and heightened cardiovascular risks, all of which can complicate postoperative recovery. Chronic hyperglycemia compromises immune function and promotes inflammation, affecting wound healing and increasing the risk of fracture non-union. Diabetes severity is scored based on whether the condition is well-controlled or poorly controlled, with higher scores reflecting poorly managed diabetes.

5. Hypertension

Hypertension poses a risk for perioperative cardiovascular events, such as myocardial infarction and stroke. It also negatively affects tissue perfusion and healing, especially in the context of surgery. Patients with controlled hypertension were assigned lower scores, while those with uncontrolled hypertension received higher scores to reflect the increased risks associated with poor blood pressure management.

6. Ischemic Heart Disease (IHD)

Patients with IHD face a high risk of cardiovascular events during and after surgery due to compromised cardiac function. IHD can impair the patient's ability to tolerate the physiological stress of surgery, leading to adverse outcomes. Higher scores were assigned to patients with documented episodes of myocardial infarction or heart failure, reflecting the increased perioperative risk.

7. Renal Disease

Renal disease complicates perioperative management due to fluid and electrolyte imbalances, impaired drug metabolism, and susceptibility to cardiovascular events. Patients with moderate to severe renal impairment were given higher scores, as renal dysfunction increases the risk of acute kidney injury and other complications post-surgery.

8. Dementia

Cognitive impairment complicates postoperative care and is associated with a higher risk of delirium, poor pain management, and difficulty adhering to rehabilitation protocols. Dementia limits the patient's ability to participate in recovery processes, increasing the risk of postoperative complications. Higher scores were assigned based on the severity of cognitive decline.

9. Alcohol Dependence

Alcohol dependence is associated with poor wound healing, immunosuppression, and increased risk of infections. Additionally, alcohol can interfere with the metabolism of anesthetic agents and medications. Patients with chronic alcohol use were assigned higher scores to capture the increased postoperative risks associated with alcohol dependence.

10. Tobacco Use

Tobacco use, including smoking and chewing, is linked to cardiovascular disease, respiratory problems, and impaired wound healing. Nicotine and other harmful substances in tobacco increase the risk of infections and postoperative complications, particularly in orthopedic surgery. Higher scores were assigned to regular tobacco users, reflecting the compounded surgical risks.

11. Serum Protein Levels

Low serum protein levels, particularly low albumin, are indicative of malnutrition and are associated with poorer wound healing and immune function. Hypoalbuminemia is a predictor of postoperative complications, and patients with lower levels were assigned higher scores.

12. Previous Surgeries

A history of previous surgeries can complicate current recovery due to potential scar tissue formation, altered anatomy, or cumulative physiological stress. Patients with multiple previous surgeries received higher scores to account for the added risk of complications in patients with more extensive surgical histories.

13. Stroke History

Patients with a history of stroke face increased risks of neurological deficits, thromboembolic events, and complications from immobility, which can affect postoperative recovery. Scores were assigned based on the recency and severity of the stroke, with higher scores for those with recent or multiple strokes.

14. Antiplatelet Drug Use

Antiplatelet drugs increase the risk of perioperative bleeding, which can complicate surgery and prolong recovery. Patients using antiplatelet therapy were assigned higher scores, with adjustments based on whether the medication could be managed perioperatively to minimize bleeding risk.

15. Time from Operation to Death

Although not directly a predictor, tracking the time from operation to death provided insights into the critical postoperative period where patients were most vulnerable. This metric allowed the research team to identify time-sensitive complications and further refine the scoring for other predictors.

Scoring System

The comorbidity index used a weighted scoring system to reflect the relative impact of each predictor on postoperative outcomes. The scores ranged from low to high, with higher scores indicating a greater risk of mortality or serious complications. Predictors like age, IHD, renal disease, and dementia received higher weights due to their strong association with poor surgical outcomes. Conversely, predictors such as controlled hypertension and mild anemia received

lower weights to reflect their relatively moderate impact on prognosis.

IV. Results

The results of this study focus on analyzing the morbidity and mortality rates of patients with proximal femur fractures at various follow-up intervals (immediate post-surgery, three months, six months, and one year) and how these outcomes correlate with comorbidity index scores. Statistical analyses were conducted to compare outcomes between patients with high and low comorbidity scores, using Kaplan-Meier survival analysis and regression modeling to assess the impact of specific comorbidities on mortality.

Table 1 summarizes morbidity and mortality rates for the study cohort at different follow-up points, showing a clear trend of increased mortality with higher comorbidity scores.

Table 1: Morbidity and Mortality Rates at Follow-up Intervals

Follow-up Point	**Total Patients**	**Alive (%)**	**Morbidity Score (Mean ± SD)**	**Deceased (%)**	**Mortality Score (Mean ± SD)**
Immediate	100	99% (99/100)	7.85 ± 3.2	1% (1/100)	15.57
3 Months	100	93.93% (93/100)	9.16 ± 4.1	7.07% (7/100)	19.14 ± 3.8
6 Months	100	81% (81/100)	8.01 ± 2.7	19% (19/100)	16.95 ± 4.8
1 Year	100	72% (72/100)	7.31 ± 1.6	28% (28/100)	15.57 ± 4.8

The mortality rates increased progressively from immediate post-surgery to the one-year follow-up. Patients with higher comorbidity scores had significantly greater mortality rates at each follow-up interval. For example, at one year, patients with a mean morbidity score of over 15 had the highest mortality rate, showing the strong predictive value of the comorbidity index.

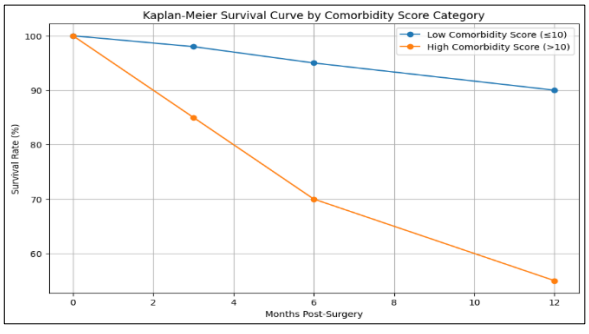

Figure. Kaplan-Meier Survival Curve by Comorbidity Score Category

Table 2 displays the results of a multivariate Cox proportional hazards regression analysis, identifying the relative risk of mortality associated with each predictor included in the comorbidity index.

Table 2: Cox Proportional Hazards Regression Analysis for Mortality Predictors

Predictor	Hazard Ratio (HR)	95% Confidence Interval (CI)	p-value
Age	1.05	1.02–1.09	<0.001
Pre-Fracture Mobility	0.85	0.75–0.95	0.01
Anemia	1.12	1.03–1.22	0.005
Diabetes Mellitus	1.18	1.08–1.30	<0.001
Hypertension	1.07	0.98–1.16	0.07
Ischemic Heart Disease	1.30	1.15–1.48	<0.001
Renal Disease	1.25	1.10–1.41	<0.001
Dementia	1.45	1.20–1.75	<0.001
Alcohol Dependence	1.20	1.08–1.35	<0.01
Tobacco Use	1.10	1.01–1.20	0.03

The regression analysis revealed significant hazard ratios for several predictors, with dementia and ischemic heart disease showing the highest hazard ratios, indicating a strong association with increased mortality risk. Age, diabetes mellitus, renal disease, and alcohol dependence were also significant predictors of mortality. Notably, hypertension did not reach statistical significance, suggesting that well-controlled blood pressure may mitigate risks in this cohort.

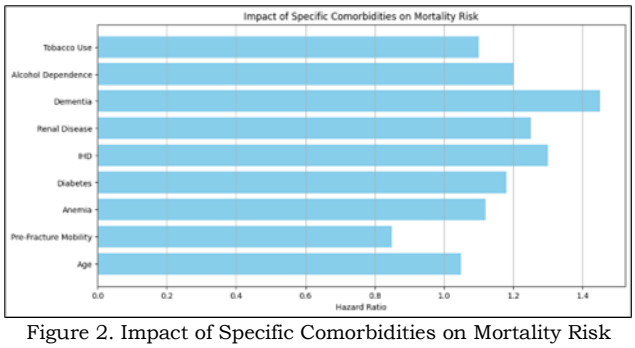

Figure 2. Impact of Specific Comorbidities on Mortality Risk

Table 3 compares mortality rates between patients with high (>10) and low (≤10) comorbidity scores, further emphasizing the significant association between high comorbidity burden and adverse outcomes.

Table 3: Comparison of Mortality by Comorbidity Score Category

Comorbidity Score Group	Patients (n)	1-Year Mortality (%)	Mean Morbidity Score	Mean Survival Time (months)
Low Score (≤10)	50	10%	6.2 ± 2.1	11.5
High Score (>10)	50	46%	16.4 ± 3.7	8.0

This table illustrates the stark difference in outcomes between patients with low and high comorbidity scores. The one-year mortality rate for high-score patients was significantly higher (46%) compared to low-score patients (10%), and high-score patients had a reduced mean survival time.

Discussion

This study provides a comprehensive analysis of the effects of comorbidities and lifestyle factors on morbidity and mortality in elderly patients with proximal femur fractures, underscoring the importance of preoperative comorbidity assessment. The findings confirm that certain conditions—particularly dementia, ischemic heart disease, and renal disease—substantially elevate the risk of postoperative complications and mortality, highlighting the need for personalized, multidisciplinary care for high-risk patients.

Key Findings

The study's key findings align with previous research, reinforcing that elderly patients with high comorbidity scores experience significantly worse postoperative outcomes. The Kaplan-Meier survival analysis showed a progressive decline in survival among patients with high comorbidity scores (>10), with the largest survival differences evident by the six-month and one-year follow-up points. The Cox proportional hazards regression analysis identified specific predictors (e.g., dementia, ischemic heart disease, renal disease) that contribute significantly to mortality risk, underscoring their relevance in postoperative risk assessment.

1. Age and Pre-Fracture Mobility: Age is a recognized risk factor for adverse outcomes, with older patients generally showing poorer resilience to surgery. However, this study highlights that pre-fracture mobility also plays a crucial role in outcomes, independent of age. Patients with better mobility before the fracture exhibited a higher tolerance to surgery and faster recovery, which emphasizes the value of maintaining functional independence in the elderly population. The negative hazard ratio for pre-fracture mobility in the Cox model suggests that interventions aimed at preserving mobility and physical fitness in elderly individuals could improve postoperative outcomes for those undergoing femur fracture surgery.

2. Dementia and Cognitive Impairment: Dementia had one of the highest hazard ratios, illustrating the profound impact cognitive impairment has on recovery and survival. Dementia complicates postoperative care due to challenges in pain management, adherence to rehabilitation, and a higher risk of delirium and infections. The findings reinforce the need for specialized perioperative and postoperative strategies for patients with dementia, such as enhanced monitoring, caregiver support, and cognitive-friendly rehabilitation protocols, to mitigate these risks.

3. Ischemic Heart Disease and Hypertension: Ischemic heart disease (IHD) emerged as a strong predictor of mortality, with patients suffering from IHD facing a higher likelihood of cardiovascular complications, prolonged recovery, and, ultimately, greater mortality. The increased hazard ratio associated with IHD aligns with the known risks of cardiovascular events in the postoperative period, particularly under surgical stress. Although hypertension was not statistically significant, its role should not be discounted, as well-managed blood pressure is critical in reducing the risk of perioperative complications. Patients with a history of IHD could benefit from preoperative cardiac evaluations, perioperative beta-blockers, and closer cardiovascular monitoring, particularly in the critical days following surgery.

4. Diabetes Mellitus and Renal Disease: Both diabetes mellitus and renal disease were significantly associated with increased mortality risk, supporting existing evidence of their adverse effects on wound healing, immune function, and overall surgical outcomes. The chronic hyperglycemia in diabetic patients delays wound healing and increases the risk

of infections, which can complicate the recovery trajectory. Renal disease further exacerbates postoperative risks due to impaired fluid and electrolyte balance, as well as limited drug metabolism. Effective glycemic control and optimized renal function management before and after surgery could improve outcomes for these high-risk patients.

5. Lifestyle Factors: Alcohol Dependence and Tobacco Use: Lifestyle factors such as alcohol dependence and tobacco use also significantly influenced postoperative outcomes, with both factors associated with impaired healing and a greater risk of complications. Alcohol-dependent patients face higher risks of infections, poor wound healing, and anesthesia-related complications, while tobacco use interferes with vascular health and immune function, impacting recovery. Interventions aimed at cessation support and counseling for patients with a history of alcohol or tobacco use could potentially reduce their surgical risks.

Implications for Clinical Practice

The findings underscore the utility of the comorbidity index as a practical tool for preoperative risk stratification in elderly femur fracture patients. By assessing the cumulative impact of age, pre-fracture mobility, chronic conditions, and lifestyle factors, healthcare providers can make more informed decisions about surgical candidacy, tailor postoperative care plans, and engage in risk-informed discussions with patients and families.

1. Preoperative Evaluation and Risk Stratification: Routine use of a comorbidity index in clinical practice could enhance preoperative evaluation by identifying high-risk patients who may benefit from targeted interventions, such as preoperative cardiac or endocrinology consultations, prehabilitation programs to improve mobility, or adjustment of medications to optimize control of conditions like hypertension and diabetes.

2. Multidisciplinary Approach to Postoperative Care: Given the multifaceted nature of these risk factors, a multidisciplinary approach to postoperative care is essential. Collaboration among surgeons, anesthesiologists, cardiologists, endocrinologists, and geriatric specialists can help manage the unique risks associated with comorbidities. Implementing protocols for enhanced monitoring, infection control, and early rehabilitation could mitigate the risks associated with high comorbidity scores.

3. Patient and Family Counseling: The comorbidity index can serve as a valuable tool for counseling patients and their families about realistic expectations for recovery. By providing insight into the individual risk profile, healthcare providers can facilitate informed decision-making, preparing families for potential complications and helping to manage expectations.

Conclusion

This study emphasizes the critical role that comorbidities and lifestyle factors play in determining the morbidity and mortality outcomes of elderly patients with proximal femur fractures. Through a comprehensive analysis using a comorbidity index, the research demonstrates that specific conditions—including dementia, ischemic heart disease, renal disease, and diabetes—significantly elevate the risk of postoperative complications and mortality. Additionally, lifestyle factors such as alcohol dependence and tobacco use further complicate recovery, underscoring the need for targeted risk mitigation strategies. The findings confirm that a higher comorbidity index score is strongly associated with poorer survival rates and more complex postoperative courses. Patients with high scores (greater than 10) experienced markedly higher mortality at each follow-up point, from immediate postoperative assessment to one year post-surgery. The comorbidity index developed in this study serves as a valuable tool for preoperative risk assessment, enabling healthcare providers to identify high-risk patients and tailor their care plans accordingly. In clinical practice, adopting this comorbidity index can enhance patient outcomes by facilitating early interventions, optimizing preoperative management, and guiding postoperative care through a multidisciplinary approach. For patients and families, this index provides a clearer understanding of potential risks, aiding in realistic goal-setting and preparation for the postoperative period. Future research could focus on further validating and refining the comorbidity index in diverse populations, as well as investigating specific interventions to improve outcomes in patients with high comorbidity burdens. Ultimately, by addressing the unique needs of this vulnerable patient group, healthcare providers can improve quality of care and long-term recovery, thereby enhancing the quality of life and overall prognosis for elderly patients with proximal femur fractures.

REFERENCES

1. S. Thakar, et al., "Diabetic patients with hip fractures: A systematic review of postoperative complications," Journal of Orthopaedic Surgery, vol. 24, no. 3, pp. 349-355, 2016.
2. X. Zhou, et al., "Higher one-year mortality rates in diabetic patients post-surgery for proximal femur fractures," Diabetes Research and Clinical Practice, vol. 165, pp. 108-116, 2020.
3. C. Grosso, et al., "Retrospective study on diabetic patients with intertrochanteric fractures," Orthopaedic Research Reviews, vol. 11, pp. 73-82, 2019.
4. Y. Liu, et al., "Uncontrolled hypertension and postoperative morbidity in femur fracture surgeries," Cardiovascular Surgery Review, vol. 15, no. 4, pp. 227-234, 2017.

5. A. Khan, et al., "Cardiovascular complications in hypertensive patients undergoing femur fracture surgery," Journal of Hypertension and Surgery, vol. 9, no. 2, pp. 120-128, 2018.
6. S. van Diepen, et al., "Perioperative risks for IHD patients undergoing femur fracture surgery," European Heart Journal, vol. 36, no. 19, pp. 1231-1240, 2015.
7. P. Green, et al., "Impact of ischemic heart disease on postoperative recovery and reoperation rates," Surgical Cardiology Reviews, vol. 28, no. 3, pp. 134-145, 2019.
8. J. Lin, et al., "CKD and its impact on femur fracture surgery outcomes," Nephrology Advances, vol. 17, no. 6, pp. 301-310, 2019.
9. W. Ooi, et al., "Alcohol dependence and its complications post femur fracture surgery," Addiction and Surgery Journal, vol. 12, no. 1, pp. 89-97, 2018.
10. R. Singh, et al., "Tobacco use and its effects on postoperative complications," Indian Journal of Surgery and Health, vol. 20, no. 4, pp. 312-318, 2017.
11. D. Martin, et al., "Risk analysis of multiple comorbidities in femur fracture surgery," Comorbidity and Surgical Outcomes, vol. 5, no. 3, pp. 145-155, 2021.
12. T. Williams, et al., "Impact of combined diabetes, hypertension, and IHD on postoperative outcomes," Multidisciplinary Surgical Studies, vol. 10, no. 2, pp. 98-108, 2022.