



## Predictor Parameters of One Year Mortality in Elderly Patients with Intertrochantric Femur Fractures

### KEYWORDS

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### ABSTRACT *Background and Objectives:*

The purpose of this study was to investigate the contributing value of the nutrition related blood parameters to one year mortality intertrochantric fracture surgery in a Indian population over the age of 65.

### *Methods and Study design:*

Nutritional status was evaluated by using admission serum albumin and total lymphocyte count(TLC).One hundred and seventy four intertrochantric fracture patients were entered into this study for nutritional status assessment.Gender differences were evaluated by univariate analysis. The predictive value of the variables for one year mortality was assessed by multiple logistic regression analysis.

### *Results:*

The mean albumin was 3.1 mg/dl with 73% of patients less than 3.5mg/dl and the mean TLC was  $1.19 \times 10^9$  cells/L with 81% less than  $1.50 \times 10^9$  cells/l. There was no significant differences in albumin( $p=0.674$ ) or TLC ( $p=0.804$ ) between men and women. Survival information was obtained in 88 patients who received surgical treatment. The general one year mortality was 31% with 35% in men and 29% in women, respectively. The surviving patients were younger and had higher albumin, TLC and calcium than those who died. However multivariate analysis identified only serum albumin and TLC as independent and significant risk factors associated with one year mortality, the optimal cut off-points were 2.95 g/L and  $0.93 \times 10^9$  cells/L respectively.

### *Conclusions:*

Malnutrition is a common phenomenon in the aged Indian population suffering from intertrochantric fractures. A lower serum albumin level and total lymphocyte count at admission are significant risk factors to predict the one-year mortality.

### Introduction

Intertrochantric fracture, a subset of hip fracture, is one of the most common injuries the elderly people and, together with the femoral neck fracture, presents perhaps the most important public health problem facing orthopaedic surgeons today. Aged people with hip fractures are at considerable risk for premature death<sup>1-5</sup> with the increased mortality during the 1st year after the surgery from 8.4% to 35%. Although numerous studies have focused on the risk factors for mortality following hip fracture surgery, there is no conclusive evidence yet what preoperative factors predict postoperative mortality<sup>6</sup>.

Elderly patients with hip fracture are more likely to be malnourished on admission when compared to the age matched general population<sup>7,8,9</sup>. Poor nutritional status is known to be both a common causative factor of the hip fractures and a predictor of excess mortality following surgical intervention<sup>10,11</sup>. Many methods including anthropometry, the mini-nutritional assessment, nutrition related blood parameters and dietary analysis are used for nutritional status assessment in clinic<sup>12,13</sup>. Serum albumin and total lymphocyte count are the two most important blood markers for nutritional status<sup>14</sup> and have been recognized as prognostic factors of hip fractures<sup>15-18</sup>. Several studies have demonstrated serum albumin<sup>14,16,17,19-22</sup>

or TLC<sup>16,17,22</sup> on admission to be independently predictive of postoperative mortality in aged people with hip fracture. However most of the studies have not analysed different fracture types per se may be influenced by nutrition status and may be predictive of mortality.

The purpose of the study was to assess the nutritional status of intertrochantric fracture patients from a Indian population aged over 65 years by preoperative serum albumin and total lymphocyte count. In addition, the relationship between these blood markers and the patients one year mortality has been evaluated.

### Materials and Methods

#### Study design and data collection

All patients were admitted to a tertiary care hospital with an acute intertrochantric femur fracture over a 24 month (January 2013- December 2014) and studied retrospectively. The basic information was taken from the medical records and discharge registration system. Then the original medical records which contain all laboratory test results of the inpatients were retrieved from the record room of the hospital. Patients younger than 65 years of age, with multiple fractures or malignant pathological fractures, and those not managed operatively were excluded from the study.

The demographic data (age and gender) and five preoperative blood parameters (serum albumin, TLC, haemoglobin, serum potassium and calcium) were entered into the confidential database (MS excel). The preoperative serum albumin and TLC results were used as the sole markers of nutritional status. For each patient, 5 ml venous blood sample was collected in the morning after admission. The level of TLC and albumin were detected by automatic blood cell analyser respectively. Values of serum albumin (3.5 mg/dl) and TLC ( $1.5 \times 10^9$  cells/l) below the lower laboratory reference range were taken to represent malnutrition [14, 16]. The proportion of patients with either or both parameters below the normal level was calculated and gender differences in age, blood parameters and mortality were analysed.

Fracture type and surgical intervention were confirmed according to the operation records. As intramedullary fixation is the first choice of surgical treatment for intertrochantric fractures in hospital, a majority of the fractures were stabilised with the gamma nail (GN) or the proximal femoral nail (PFN). The operating procedures were similar, the main difference being the type of implant [25]. All surgeries were performed according to the standard protocols of either GN or PFN by experienced surgeons. Fractures treated with other fixation methods for example Dynamic hip screws (DHS), were excluded from the study.

A telephonic follow up survey as well as national database of population death registration was performed one year after surgery of each case. If the patient was absent, then family member was contacted. If required home visit was made. If still survival information could not be obtained patient was excluded from the study.

### Statistical analysis

Continuous variables were described as mean  $\pm$  standard deviation. Categorical variables were presented in terms of their frequency. The gender difference in one year mortality was tested using Pearson Chi squared method. The independent sample *t*-test was used to compare the mean level of blood parameters between male and female patients. An univariate analysis of variance was performed on data from patients who survived one year postoperatively and on data from those who did not. The relative contribution of the variables to mortality was identified using a multiple logistic regression analysis with a forward stepwise variable selection. The results of multivariate analysis were expressed in terms of hazard ratio derived from the estimated regression coefficients with 95% confidence intervals. Statistical analysis was performed using the Statistical package for the social sciences 17.0 version from windows program (SPSS). *p*-values  $< 0.05$  were considered significant. The optimal cut off points of the significant factors were determined using a receiver operating characteristic curves [26].

### Results

One hundred and seventy four patients with intertrochantric fracture over the age of 65 years were admitted during the study period. Nutritional and demographic data were admitted during the study period. Nutritional and demographic data were available for all 174 patients of whom 116 (67%) were women and 58 (33%) were men. The gender difference and blood parameters at admission are shown in table 1. The only significant difference index is haemoglobin where the level of haemoglobin in male patients is higher than that in female patients. The mean albumin for all patients was  $3.1 \pm 0.53$  mg/dl (range 1.8

to 4.3, median 3.1) with albumin level less than 3.5 mg/dl occurred in 127 (73%) patients. The mean TLC was  $(1.19 \pm 0.51) \times 10^9$  cells/l (range 0.29 to  $3.47 \times 10^9$  cells/l; median  $1.1 \times 10^9$  cells/l) with 141 (81%) patients lower than  $1.5 \times 10^9$  cells/l. 52% of the patients had both albumin and TLC levels lower than normal.

Seven patients receiving non operative treatment and two treated with DHS stabilisation were excluded from the mortality study. Sixteen patients were lost to follow up of one year after surgery leaving survival data for 149 patients (86%). The mean age of the patients was  $80.9 \pm 7.5$  (range 65-97 median 82). Females ( $n=98$ ; 66%) outnumbered males ( $n=51$ ; 34%). Forty six patients died within one year postoperatively and the overall mortality rate was 31%. Two patients died of pulmonary infection during their hospital stay and both of them had low albumin and TLC levels at admission. One hundred eleven (74%) patients were malnourished based on albumin levels less than 3.5 mg/dl of whom 45 (41%) died. Only one patient (3%) died with admission albumin  $> 3.5$  mg/dl ( $p < 0.001$ ). There was no difference in one year mortality between the patients (23%, 6/26) with  $TLC > 1.5 \times 10^9$  cells/l and those (31%, 40/123) with  $TLC < 1.5 \times 10^9$  cells/l ( $p = 0.344$ ). Demographic characteristics and blood parameters of the survivors and non survivors are summarised in table 2. Variables comparison between two groups (survival at one year post surgery or not) found that age ( $p = 0.018$ ), serum albumin level ( $p < 0.001$ ), TLC level ( $p = 0.006$ ) and serum calcium level ( $p = 0.010$ ) had significant differences. However multiple logistic regression analysis with stepwise variable selection showed that only serum albumin level ( $p < 0.001$ , Hazard ratio 1.22) and TLC level ( $p = 0.008$  hazard ratio 3.90) at hospital admission had significant association with one year mortality (table 3).

**Table 1 : Univariate analysis comparing the age and blood parameters between elderly male and female patients with intertrochantric fracture**

Variable	Men	Women	p-value
Age	$79.4 \pm 7.34$	$81.8 \pm 7.46$	0.067
Serum albumin (mg/dl)	$31.1 \pm 5.70$	$30.8 \pm 5.00$	0.674
Total lymphocyte count ( $\times 10^9$ /l)	$1.16 \pm 0.48$	$1.18 \pm 0.55$	0.804
Haemoglobin (g/l)	$107 \pm 20.1$	$100 \pm 13.2$	0.027
Serum potassium (mmol/l)	$3.93 \pm 0.40$	$3.84 \pm 0.45$	0.255
Serum calcium (mmol/l)	$2.13 \pm 0.12$	$2.12 \pm 0.14$	0.975

Variables are reported as mean  $\pm$  standard deviation

**Table 2**

Variable	Die	Live	p-value
Gender, men (%)	18 (35.3)	33 (64.7)	0.399
Age	$83.1 \pm 7.59$	$80 \pm 7.25$	0.018
Serum albumin (mg/dl)	$27.7 \pm 4.15$	$32.3 \pm 5.06$	$< 0.0001$
Total lymphocyte count ( $\times 10^9$ /l)	$1.00 \pm 0.45$	$1.26 \pm 0.54$	0.006
Haemoglobin (g/dl)	$99.7 \pm 14.9$	$104 \pm 16.6$	0.146
Serum potassium (mmol/l)	$3.95 \pm 0.50$	$3.84 \pm 0.40$	0.173
Serum calcium (mmol/l)	$2.09 \pm 0.14$	$2.15 \pm 0.12$	0.010

**Table 3 : Multiple logistic regression analysis for one year mortality after surgery in elderly intertrochantric fracture patients**

Variable	Regression coefficient	Standard error	Test statistics
Gender,men	0.554	0.442	1.57
Age	-0.042	0.032	1.71
Serum albumin(mg/dl)	0.202	0.050	16.0
TLC(*10 <sup>9</sup> /l)	1.361	0.509	7.14
Haemoglobin(g/l)	0.004	0.014	0.067
Serum potassium(mmol/l)	-0.879	0.497	3.12
Serum calcium(mmol/l)	-0.532	1.819	0.085

### Discussion

The incidence of hip fracture is increasing, paralleling the increased longevity of the global population(27).Almost 9 out of 10 hip fractures occur in patients older than 65 years and approximately half will be intertrochantric fractures. Many studies have investigated the mortality of hip fractures in elderly patients and most include all types of hip fractures grouped together. It is generally known that intertrochantric fractures are slightly older and sicker than femoral neck fractures(28).Survival studies focusing on fracture type have demonstrated that intertrochantric fracture patients have a higher post operative mortality rate than fracture femoral neck fracture(24,28,29).Since so many differences exist in patient characteristics, surgical management and outcomes between femoral neck fractures and intertrochantric fractures it is reasonable to single out these specific fracture group for risk predictor evaluation. Here, we focus on the relationship between the nutritional status and long term mortality following surgery in an aged Indian patient group admitted with a femur intertrochantric fracture. We found a high rate of malnutrition among these patients based on serum albumin and TLC levels at admission, and we demonstrated that both of these parameters can significantly predict one year mortality in this patients group.

The increased prevalence of poor nutritional status among older adults with hip fractures compared to the general population has been well documented(7-11,13,14,16,18-21).Malnutrition combined with the catabolic response to trauma or surgery,leads to muscle wasting and has been associated with post operative complications,18 increased length of stay 15,17 and mortality 14,19-21.However most of these studies were based on patients from developed western countries.The nutritional status of hip fractured patients from a developing country such as India with a different healthcare delivery system is still unclear.In the present study,we employed admission serum albumin and TLC level as markers of nutrition assessment.Both of them are routine preoperative laboratory results in hospital and numerous studies have used a combination of albumin and TLC levels to identify whether the patients are under a state of protein energy malnutrition 14,16,19.According to widely accepted reference value,3.5 gm/dl for albumin and 1.5\*10<sup>9</sup> cells/l for TLC,we observed 73% of the patients included in this study with a low albumin level,81% with a low TLC level and 52% with both under the reference values.The incidence of malnutrition is much higher than the reported by Koval et. Al.They evaluated nutritional status of 490 hip fractures patient aged 65 years and older in the united states and reported 18% patients with low albumin,57% with low TLC,and only 9% having both parameters below the normal value 16.Because previous studies have demonstrated a relationship between low

haemoglobin level and increased mortality in hip fracture patients,22,30,we included this parameter in the current study.However we failed to discover haemoglobin as a predictor for one year mortality in this patient group.

Mortality rate observed in this study is comparable with those reported in literature for hip fracture where one year mortality rate range from 8.4% to 36% 21.One prospective study among elderly women with a hip fracture was conducted to determine whether the survival outcome differed by fracture type.They revealed one year mortality in intertrochantric fracture patients at 28% which was markedly higher than their 11% mortality in femoral neck fracture patients 24.The relationship of fracture type and mortality in geriatric hip fractures patients was not specifically addressed in a systemic review by Butler et al. 31.Thus the impact of fracture type to postoperative mortality in hip fractures patients need further evaluation.Several investigators have demonstrated the predictive value of serum albumin below 3.5 gm/dl was predictive for increased length of stay and in hospital mortality and total lymphocyte count below 1.5\*10<sup>9</sup> cells/l was predictive for one year mortality.They also reported that patients with abnormal albumin and total lymphocyte counts were 3.9 times more likely to die within one year after surgery.In a similar study by O'Daly et al,survival analysis of 200 patients with hip fracture showed patients with low albumin and TLC levels were more likely to die within 12 months but only serum albumin age were found to be significant independent prognostic factors 14.On the contrary,a study from Singapore evaluating the risk factors for mortality in elderly patients with hip fractures revealed patients with low albumin levels and TLC level had a lower mean survival time. However,the albumin level lost its predictive value of mortality after multivariate analysis 28.Recently,a systematic review and meta-analysis concluded that low-albumin and TLC just had moderate or limited evidence in predicting mortality following hip fracture surgery 6 which indicates that further studies are needed to re-evaluate their predictive values.

There are several limitations in this study.First it is a retrospective study, and thus completeness of medical records was limited with regard to preoperative comorbidities,functional status and cognitive level which were found to be significant factors of one year mortality 3,20,22.Future studies should include a comprehensive assessment of patient characteristics to investigate the strength of albumin and TLC as predictors of mortality in hip fractured patients.The unmeasured differences in medical therapies may contribute to the results. Likewise,nutritional intervention is also very important.It has been shown to modify nutritional parameters and albumin levels,but it still not regularly managed for the hip fractured patients in hospital.The impact of surgical delay was not included,because surgical decision doesnot always completely depend on the patients condition.Sometimes surgery has to be postponed,because all members could not reach the consensus.The multivariate Cox regression should be a better statistical for survival analysis if we can get the exact death time of the patients.The postoperative complication,the functional outcome and the cause of death were not recorded in this study which is essential for a fracture repair.The relationship between the nutritional status and functional recovery will be studied in the future and is not the purpose of this study.

In conclusion,serum albumin and TLC are useful clinical markers for nutritional assessment and effective predic-

tors on one year mortality in aged patients with intertrochantric fracture. In combination, they provide valuable information, help in to identify those patients who are candidates for interventions which might reduce their risk of premature death. Whether a strategy of nutritional support to improve serum albumin could improve survival rate in these high-risk patients warrants further evaluation.

#### Author Disclosures

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