ORIGINAL RESEARCH PAPER
Volume - 12 | Issue - 02 | February - 2023 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

SERUM ALBUMIN INDICATES MORBIDITY IN GERIATRIC PATIENTS OPERATED FOR HIP FRACTURES: A PROSPECTIVE COHORT STUDY

Orthopedics

Dr. Nikhil Bhandari* Senior Resident, Department of Orthopaedics, Bharati Vidyapeeth Deemed University, Pune. *Corresponding Author

Dr. Gururaj Joshi Professor & Head of Department, Department of Orthopaedics, Bharati Vidyapeeth Deemed University, Pune.

ABSTRACT

Introduction: Serum albumin is one of the best-accepted and most widely used markers of nutritional status, making it better marker of malnutrition, in which patients are considered to be malnourished when serum albumin concentration is < 3.5 g/dL. Previous studies have shown that patients with low serum albumin levels have increased risk of post-operative complications and mortality following a surgical procedure as compared to those with normal serum albumin levels. The purpose of this study was to test if serum albumin level is associated with increased morbidity, specific postoperative complications (hypertension, bronchial asthma and diabetes), length of hospital stay, and readmission in geriatric patients undergoing a surgical procedure for hip fracture. **Methods:** A prospective cohort study of geriatric patient (more than 60 years of age) undergoing surgical procedure for hip fractures in Department of Orthopaedics in a tertiary care teaching hospital in Pune for a period of 2 years. Outcomes were compared between patients with low and normal serum albumin level. The patients were followed up in the early post-operative period (before discharge), at 3 month and at 6 months. Statistical analysis was carried out using software SPSS- statistical package for social sciences version 25. **Results:** There were 76 patients undergoing a surgical procedure for hip fracture who met inclusion criteria. When the patients divided on the basis of serum albumin level considering the cut-off point of 3.5 g/dL, and the demographic and clinical parameters were compared between the groups. There was significant difference in the mean age and gender distribution among the groups. The length of the hospital stay was also more in patients whose albumin level was below the cut off value 9.16 ± 6.43 compared with those with normal serum albumin 6.30 ± 3.35. At the time of follow-up of 3 months and 6 months the rate of complications was noted to be higher in patients with low serum albumin level patients. **Conclusion:** This study demarcates the importance of serum albumin as an autonomous nutritional factor to determine risk of morbidity and mortality in the peri-operative period. Hence, pre-operative estimation of serum albumin levels and its timely correction can help in avoiding the peri-operative complications and facilitate early recovery.

KEYWORDS

Hypoalbuminemia, Hip fractures, Nutrition

INTRODUCTION:

Hip fracture is a fracture of the upper portion of the femur (anywhere from femoral head to about 5 cm below lesser trochanter).[1,2] Intracapsular hip fractures include femoral neck fractures and femoral head fractures, and extracapsular hip fractures include intertrochanteric fractures and subtrochanteric fractures.[3] Adults > 65 years old most commonly present with hip fracture and 90% of hip fractures are reported to be associated with domestic falls.[4,5]

The incidence of hip fracture is estimated to rise from 1.66 million in 1990 to 6.26 million in 2050.[6] The incidence increases with age, doubling for each decade beyond the age of 50 years. These fractures are usually associated with increased mortality, disability and dependence on others. They also have significant implications for morbidity, mortality, hospital utilization and the cost of care in the community.

Surgery for hip fractures is generally considered an intermediate-risk procedure with increased risk for perioperative morbidity and mortality. These fractures are considered semi-urgent and the surgeries should be performed within 24-48 hours of admission if possible. Increased risk for postoperative complications, including pneumonia, heart failure, and death are associated with these procedures.[7]

Malnutrition has been identified as another potential risk factor for poor outcomes following orthopaedic procedures. It increases the risk of surgical-site infections, pneumonia, wound dehiscence, and urinary tract infections also increasing the length of hospital stays, health care costs, and mortality following these orthopaedic procedures. Malnourishment may be aggravated by pre-operative semi-starvation due to pre-operative fasting, long delays pre-surgery, moderate to severe pain, nausea and vomiting.[8,9,10]

Serum albumin is one of the best-accepted and most widely used markers of nutritional status, patients are considered to be malnourished when serum albumin concentration is <3.5 g/dL. Previous studies have shown that patients with low serum albumin levels have increased risk of post-operative complications and mortality following a surgical procedure as compared to those with normal serum albumin levels.[11]

The purpose of this study was to test if pre-operative serum albumin level is associated with increased morbidity, specific postoperative complications, length of hospital stay, and readmissions in geriatric patients undergoing a surgical procedure for hip fracture.

MATERIAL AND METHODS:

The present prospective cohort study was carried out in the Department of Orthopaedics at a tertiary care hospital in Pune from 1st October, 2019 to 31st September, 2021. Patients with age 60 years and above sustaining fracture of proximal femur attending out-patient department or the casualty were enrolled in the study. Patients with compound fractures of proximal femur, fractures of femoral head, pathological fractures, chronic renal and liver disorders and ones with associated pelvic fractures were excluded from the study.

A sample size of 76 patients with proximal femur fracture was calculated keeping an allowable error of 8% All patients were made to sign an informed consent form at the time of enrolment. Those not willing to sign the informed consent were excluded from the study. On admission, blood and urine routine investigations including serum albumin levels were sent for each patient. 3.5 g/dl was decided as the cut-off for the serum albumin levels.

On the basis of pre-operative serum albumin levels, the study population was divided into two cohorts. Group 1 included the patients with serum albumin levels below the cut-off limit (<3.5 g/dl) whereas Group 2 included the patients with serum albumin levels above the cut-off limit (>3.5 g/dl).

Each patient underwent an operative procedure for the respective fracture pattern. Bipolar hemiarthroplasty, fixations using cancellous cannulated screws, intra-medullary interlock nailing and dynamic hip screw plating were the procedures studied. Length of the hospital stay was standardized and calculated from the day of the surgery to the day of discharge to eliminate the bias arising from varied time required for patient optimization pre-operatively.

Patients were followed up in the out-patient department or via telephonic communication. Evaluation was done in the early post-operative period (before discharge), at 3 month and at 6 months post-surgery. Patients were examined for signs of any wound dehiscence, surgical site infections and any other post-operative complications. A

designed proforma was filled for each patient with personal details, history, clinical examination, investigations, radiological findings, type of fracture, type of surgical procedure performed, and early post-operative wound examination, length of hospital stay, 3 months and 6 months follow-up.

Statistical analysis was carried out using software SPSS- statistical package for social sciences version 25. The continuous variables were presented as Mean ± standard deviation (SD). The number of patients was presented as 'n' and percentages '%' The difference in the means was compared by using students't' test. The difference in the proportions was tested by means of chi-square test.

RESULTS:

Total 76 patients were included, out of which 34 (44.74%) were males and 42 (55.26%) were females, with mean age 74.83 ± 7.64. Comorbidities reported were DM, hypertension, bronchial asthma, Post PTCA, carcinoma, stroke and epilepsy. 13.16% of patients were smokers and 10.53% were alcoholic.

X-ray findings revealed the involvement of right IT femur fracture among 43.42%, and 25% on left side. The Neck femur fracture was on Left side among 17.11% and on right side among 10.53%. The left side subtrochanteric femur fracture was confirmed in 2.63% and on right side in 1.32%.

The hospital stay was extended among 33 patients in study population due to various reasons; the most prevalent were electrolyte imbalance and surgical site infections. Lower respiratory tract infection, urinary incontinence, urinary tract infection, multiple fever spikes, serosanguinous discharge from wound, post- operative seizures intraoperative hypotension and post-operative abdominal pain among the other causes. A significant difference in the mean age and gender distribution among the groups based on albumin cut-off of 3.5 g/dL was reported. The length of the hospital stay was also more in patients whose albumin level was below the cut off value. [Table no. 1]

Table 1: Reason for extended hospital stay

Reason for extended hospital stay	N	%
Electrolyte imbalance	10	13.33
Intraoperative hypotension	1	1.33
Lower respiratory tract infection	3	4.00
Multiple fever spikes	1	1.33
Post- operative Psychiatric illness	1	1.33
Post-operative Psychiatric illness	4	5.33
Sero-sanguinous discharge from wound	1	1.33
Surgical site infection	5	6.67
Urinary tract infection	4	5.33
Nil	44	58.67

There was no significant difference in the number of events noted at 3 and 6 months among these groups based on serum albumin levels. The major events reported at 3 months included implant failure due to DHS screw cut-out, surgical site infection and wound dehiscence, while 2 patients died. At 6 months the major adverse events reported were deep vein thrombosis, hardware related complications such as DHS screw back-out, osteolysis and implants loosening and serosanguinous discharge from the wound, and apart from 2 patients died at 3 months follow up, 1 more patient died at 6 months. [Table no. 2, 3 and 4]

Table 2: Comparison of demographic and clinical parameters between the groups on the basis of albumin level < and >3.5 g/dl

	Albumin <3.5 g/dl (n=31)	Albumin >3.5 g/dl (n=44)	P value
Age (years)	77.06 ± 7.56	73.11 ± 7.38	0.0268*
Male	14	19	0.00764*
Female	17	25	
DM	5(16.13)	13 (29.55)	0.2867
Hypertension	7 (22.58)	19 (43.18)	0.1097
Length of hospital stay	9.16 ± 6.43	6.30 ± 3.35	0.0143*
Unhealthy Wound condition	4 (12.90)	2 (4.55)	0.3787
Serum albumin (g/dl)	3.12 (2.08-3.5)	3.76 (3.52-4.4)	-

Table 3: List of events among the groups on the basis of albumin level < and >3.5 g/dl at 3 months follow up

	Albumin <3.5 g/dl (n=31)	Albumin >3.5 g/dl (n=44)
Implant failure due to DHS screw cut-out	2	0
Wound dehiscence	2	0
Pleural effusion	2	0
Serousangious discharge from the surgical site	2	0
Surgical site infection	1	1
Died	0	3

Table 4: List of events among the groups on the basis of albumin level < and >3.5 g/dl at 6 months follow up

	Albumin <3.5 g/dl (n=31)	Albumin >3.5 g/dl (n=44)
Bed sores	2	0
Deep vein thrombosis	1	0
Hardware related complication	2	0
Sero-sanguinous discharge from the wound	0	1
Died	1	3

DISCUSSION:

Last few years have seen major advances in our understanding of albumin. Albumin is synthesized and secreted from the liver. It is multifunctional, non-glycosylated and negatively charged plasma protein, which is used as a marker to measure the nutritional health of an individual. [12,13] Albumin works basically as a transporter protein for steroids, unsaturated fats and thyroid hormones in the blood. It significantly helps in maintaining the osmotic pressure inside the blood capillaries. It also plays a remarkable role as antioxidant potential. Serum albumin levels of 3.5 g/dl or higher is widely accepted as normal. Decrease in the level of albumin causes hypoalbuminemia. [14,15]

Proteins are said to be building blocks of the body. In many studies, it has been found that protein depletion leads to increase in mortality, morbidity, wound infection, surgical failure, sepsis as well as an impaired fracture union. Very low protein intake below that required maintaining nitrogen balance clearly lowers albumin and retards bone growth in children, but there is controversy about how dietary protein affects skeletal health in adults. Hypoalbuminemia is commonly observed in hospitalized patients with reported incidence as high as 60% of inpatients. Despite vast literature in the context of systemic disorders, the association of hypoalbuminemia with bone mineral density (BMD) has been a matter of controversy. [16-19]

Low preoperative serum albumin has been used to predict significantly higher in-hospital mortality and specific postoperative complications while a state of protein energy malnutrition (low total lymphocyte count and serum albumin; PEM) has been used as a marker of increased 3 and 12-month mortality. There are few data for preoperative serum albumin alone as a predictor of long-term mortality after fractured neck of femur. [20]

Shin KH et al [21] reviewed the medical records of 1155 consecutive patients the age was >60 years among most patients who underwent hip fracture surgery. According to a study by **Edelmuth SVCL et al** [28] the average patients' age in the sample was 77.6 years, with a predominance of the female gender. Similarly, in the present study, total 76 patients were included, out of which 34 (44.74%) were males and 42 (55.26%) were females, with mean age 74.83 ± 7.64.

In a study by **Edelmuth SVCL** [28]**,** most patients i.e., 50.7% had two or more comorbidities. Main complications included cognitive behavioural disorders, respiratory infection and of the urinary tract. **Bekeris, J et al** [27] reported various comorbidities including sleep apnoea, hypertension, obesity, valvular disease, DM, peripheral vascular disorder etc. **Shin KH** et al. [21] reported the complication "postoperative pneumonia" following hip fracture surgery was reported to be 5.1%. In the present study, out of the total 76 patients, 25% had DM while 4.21 % had hypertension. 10 (13.16%) patients were smokers and 8 (10.53%) were alcoholic. The other co-morbidities reported among the study population were bronchial

asthma (6.58%), Post PTCA (2.63%), carcinoma (2.64%) and Stroke, Epilepsy (1.32%).

Clinical comorbidities, apart from being an important risk factor for higher mortality, are also associated with the onset of immediate or late postoperative complications. Patients with hip fracture usually have a history of trauma, however, some patients (such as patients with insufficiency fractures) may not recall a specific traumatic event. X-ray is initial imaging modality for suspected hip fracture advanced imaging may be needed in cases where x-ray is negative but fracture is still suspected

A significantly higher 1-year mortality was recorded by **WKM Kieffer et al** [23] among patients with a serum albumin level of <3.5 g/dl. **Aldebeyana S et al** [24] **showed similar results** with patients having hypoalbuminaemia had a longer hospital length of stay.[23] In another study **Bohl DD et al**, indicated hypoalbuminemia as a powerful independent risk factor for mortality following a surgical procedure for geriatric hip fracture, with longer length of stay among patients with hypoalbuminemia at 5.67 ± 4.68 days compared with those without hypoalbuminemia at 4.99 ± 3.95 days[9]. Similarly in the present study, the hospital stay was extended among 33 patients in study population due to various reasons, the most prevalent were electrolyte imbalance and surgical site infections [Table no 1].

The patients in the current study were divided on the basis of serum albumin level considering the cut-off point of 3.5 g/dL, there was significant difference in the mean age and gender distribution among the groups. The length of the hospital stay was also more in patients whose albumin level was below the cut off value. There was no significant difference in the number of events noted at 3 and 6 months among these groups on the basis of albumin.

Li S et al reported that low serum albumin level is a sole indicator for increased risk of in-hospital death, post-operative complications, and total mortality after hip fracture surgery in older adults.[12]

Albumin is present throughout the bone matrix and evidence suggests that circulating albumin may be directly involved in fracture development. The underpinning mechanisms postulated include: (a) hypoalbuminemia may directly activate osteoclasts and inhibit osteogenesis via its relationship with nuclear factor-κB; (b) alteration in the metabolism of parathyroid hormone and vitamin D binding protein; (c) decreased Gla protein resulting in decreased osteoblastic and increased osteoclast activities; and (d) albumin has an anabolic effect on bone metabolism via its stimulatory effect on bone calcium and DNA content, hence low serum levels may be detrimental to bone. [24]

Low serum albumin level is also strongly linked to functional decline or outcomes; it is therefore plausible that low serum albumin levels cause an increase in fracture risk via the close relationship with functional decline and occurrence of falls. Furthermore, low serum albumin may just be an indicator of an underlying poor general health and nutrition.[24]

The increased risk of future fractures was shown to be associated with low serum albumin by **Kunutsora SK et al** [25]**. Aldebeyana S et al** [24] in a multivariate analysis showed that when controlling for comorbidities; hypoalbuminaemia alone was a predictor of postoperative complications (death, unplanned intubation, being on a ventilator >48 h, sepsis, and blood transfusion), and increased length of stay. **Wang, Y et al** [26] revealed preoperative hypoalbuminaemia, COPD, prior stroke and the time from injury to surgery were predominant and independent risk factors associated with POP after femoral neck fracture in this geriatric population.

CONCLUSION:

This study demarcates the importance of serum albumin as an autonomous nutritional factor to determine risk of morbidity and mortality in the peri-operative period. It also accomplishes the direct co-relation between hypoalbuminemia with high morbidity. Hence, pre-operative estimation of serum albumin levels and its timely correction can help in avoiding the peri-operative complications and facilitate early recovery.

Declarations:
Source of Funding: None.

Conflict of Interest:
The authors declare no conflict of interest

Ethical approval:

REFERENCES:

1. Florschutz AV, Langford JR, Haidukewych GJ, Koval KJ. Femoral neck fractures: current management. J Orthop Trauma. 2015;29(3):121-9
2. Sheehan SE, Shyu JY, Weaver MJ, Sodickson AD, Khurana B. Proximal Femoral Fractures: What the Orthopedic Surgeon Wants to Know. Radiographics. 2015;35(5):1563-84
3. Lu Y, Uppal HS. Hip Fractures: Relevant Anatomy, Classification, and Biomechanics of Fracture and Fixation. Geriatr Orthop Surg Rehabil. 2019;10:2151459319859139.
4. Ahuja K, Sen S, Dhanwal D. Risk factors and epidemiological profile of hip fractures in Indian population: A case-control study. Osteoporos Sarcopenia. 2017;3(3):138-148.
5. Carpintero P, Caeiro JR, Carpintero R, Morales A, Silva S, Mesa M. Complications of hip fractures: A review. World J Orthop. 2014;5(4):402-411.
6. Pioli G, Barone A, Giusti A, Oliveri M, Pizzonia M, Razzano M et al. Predictors of mortality after hip fracture: results from 1-year follow-up. Aging Clin Exp Res. 2006;18(5):381-7.
7. Rath S, Yadav L, Tewari A, Chantler T, Woodward M, Kotwal P et al. Management of older adults with hip fractures in India: a mixed methodsstudy of current practice, barriers and facilitators, with recommendations to improve care pathways. Arch Osteoporos. 2017;12(1):55.
8. Lim SJ, Park YS. Plain Radiography of the Hip: A Review of Radiographic Techniques and Image Features. Hip Pelvis. 2015;27(3):125-134.
9. Bohl DD, Shen MR, Hannon CP, Fillingham YA, Darrith B, Della Valle CJ. Serum Albumin Predicts Survival and Postoperative Course Following Surgery for Geriatric Hip Fracture. J Bone Joint Surg Am. 2017;99(24):2110-2118.
10. Williams DGA, Wischmeyer PE. Perioperative Nutrition Care of Orthopedic Surgery Patient. Techniques in Orthopedics, 2020;35(1):15-18
11. Moramarco S, Morciano L, Morucci L, Messinese M, Gualtieri P, Carestia M et al. Epidemiology of Hypoalbuminemia in Hospitalized Patients: A Clinical Matter or an Emerging Public Health Problem? Nutrients. 2020;12(12):3656
12. Ali S, Singh A, Mahdi AA, Srivastava RN, Shantanu K. Does Serum Albumin Level Affect the Healing Outcomes of Simple Diaphyseal Tibial Fractures? Saudi J Med Med Sci. 2016;4(2):93-97.
13. Li S, Zhang J, Zheng H, Wang X, Liu Z, Sun T. Prognostic Role of Serum Albumin, Total Lymphocyte Count, and Mini Nutritional Assessment on Outcomes After Geriatric Hip Fracture Surgery: A Meta Analysis and Systematic Review. J Arthroplasty. 2019;34(6):1287-1296
14. Bernardi M, Maggioli C, Zaccherini G. Human albumin in the management of complications of liver cirrhosis. Crit Care. 2012;16(2):211..
15. Evans TW. Review article: albumin as a drug–biological effects of albumin unrelated to oncotic pressure. Aliment Pharmacol Ther. 2002;16:6–11.
16. Roche M, Rondeau P, Singh NR, Tarnus E, Bourdon E. The antioxidant properties of serum albumin. FEBS Lett 2008;582(13):1783–1787.
17. Foster MR, Heppenstall RB, Friedenberg ZB, Hozack WJ. A prospective assessment of nutritional status and complications in patients with fractures of the hip. J Orthop Trauma. 1990;4:49–57.
18. Day SM, DeHeer DH. Reversal of the detrimental effects of chronic protein malnutrition on long bone fracture healing. J Orthop Trauma. 2001;15:47–53.
19. Einhorn TA, Bonnarens F, Burstein AH. The contributions of dietary protein and mineral to the healing of experimental fractures. A biomechanical study. J Bone Joint Surg Am. 1986; 68:1389–95.
20. Orwoll ES. The effects of dietary protein insufficiency and excess on skeletal health. Bone 1992;13:343–50.
21. Afshinnia F, Wong KK, Sundaram B, Ackermann RJ, Pennathur S. Hypoalbuminemia and Osteoporosis: Reappraisal of a Controversy. J Clin Endocrinol Metab. 2016; 101(1):167-75.
22. Shin KH, Kim JJ, Son SW, Hwang KS, Han SB. Early Postoperative Hypoalbuminaemia as a Risk Factor for Postoperative Pneumonia Following Hip Fracture Surgery. Clin Interv Aging. 2020;15:1907-1915
23. Kieffer WKM, Rennie CS, Gandhe AJ. Preoperative albumin as a predictor of one-year mortality in patients with fractured neck of femur. Ann R Coll Surg Engl 2013;95:26–28
24. Aldebeyana S, Nooha A, Aoudea A, Webera MH, Harveya EJ. Hypoalbuminaemia—a marker of malnutrition and predictor of postoperative complications and mortality after hip fractures Int. J. Care Injured 2017;48:436–440
25. Kunutsor SK, Voutilainen A, Whitehouse MR, Seidu S, Kauhanen J, Blom AW et al. Serum Albumin and Future Risk of Hip, Humeral, and Wrist Fractures in Caucasian Men: New Findings from a Prospective Cohort Study. Med Princ Pract. 2019;28(5):401-409
26. Wang Y, Li X, Ji Y, Tian H, Liang X, Li N et al. Preoperative Serum Albumin Level As A Predictor Of Postoperative Pneumonia After Femoral Neck Fracture Surgery In A Geriatric Population. Clin Interv Aging. 2019;14:2007-2016.
27. Bekeris J, Wilson LA, Bekere D, Liu J, Poeran J, Zubizarreta N et al. Trends in Comorbidities and Complications Among Patients Undergoing Hip Fracture Repair. Anesth Analg. 2021 Feb 1;132(2):475-484.
28. Edelmuth SVCL, Sorio GN, Sprovieri FAA, Gali JC, Peron SF. Comorbidities, clinical intercurrences, and factors associated with mortality in elderly patients admitted for a hip fracture. Rev Bras Ortop. 2018;53(5):543-551.