

Preoperative Serum Albumin and its Outcome on Postoperative Mortality and Morbidity: A Review Article

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ABSTRACT

Albumin has crucial and markable functions in health. Hypoalbuminemia has been shown to be deeply associated with increased mortality and morbidity in hospitalized patients. Many studies were conducted in the past but none of them has a definitive result. With this literature review we aim to review near-past studies and find out the importance of preoperative serum albumin and its outcome on postoperative results.

Key words: Albumin, Mortality, Oncotic pressure, Plasma, Osmotic pressure

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INTRODUCTION

Malnutrition has been associated with several complications and is considered to be one of the major indicators of poor prognosis. Amongst the various parameter's serum albumin has traditionally been used as a significant measure of a patient's nutritional status because of its availability and low cost. Hypoalbuminemia is a deficit of albumin in the blood (adults, defined by an intravascular albumin level of <3.5g/dL).

The most concentrated circulating protein in humans is albumin, which provides for around 55–60 per cent of the serum protein. Albumin consists of 585 amino acids in a long polypeptide chain with a molecular weight of 66,500 Da. The polypeptide chain has carbohydrate moiety deficiency and is characterized by a low tryptophan and methionine material.

The circulating molecule which is mature in nature; its architecture is held by 17 disulphide bonds which holds sequences of helices of molecule. The folding of molecule and few regions being hydrophilic gives it an excellent property of binding.

The tertiary structure heart-shaped human albumin crystal molecule approximates to 80 x 30 Å. The structure is quite different in solution. The three domains are arranged in an ellipsoid pattern, giving the molecule its low viscosity. A strong negative charge of -17 is noted. The molecule being very flexible in nature can mold itself according to changes in surrounding environmental conditions and while joining with ligands. Also, due to its resiliency albumin regains its shape quite easily, owing to the disulphide bridges, which provides the desired strength, especially in physiological conditions.

Functions of albumin

Oncotic Pressure: In health, albumin makes up for 4/5th of the normal Colloidal Oncotic Pressure which equates to 25 mmHg [1]. The high colloidal osmotic pressure was due to its heavy molecular weight and its increased concentration in plasma. Present at a greater concentration than other plasma proteins and still has the greatest osmotic significance [2]. This direct osmotic effect dispenses 60% of the oncotic pressure of albumin. The remaining 40% is a consequence of its negative charge, providing an attractive force for the intravascular retention of positively charged solute particles [3].

It is the COP gradient across the capillary membrane which is of greater importance in

determining fluid shift into the interstitium rather than the absolute plasma value [4].

When excess albumin pervades, the accumulation of excess colloid is prevented not by the changes in albumin synthesis, but by increment in albumin degradation and albuminuria. The oncotic regulation site of albumin synthesis is not known, but it has been postulated to reside in the hepatic interstitial volume [5].

Lowered serum Colloid Osmotic Pressure has been reported in post-operative critically ill patients [6] decreased Colloid osmotic Pressure is related with increased postoperative complications (morbidity and mortality) in surgical patients [5].

A survival rate of 50% has been associated with serum COP of 15 mmHg [7].

Poor wound healing, compromised collagen synthesis and poor immune responses are related with low serum albumin. The higher risk of post-operative complications in hypoalbuminemic patients may be clarified.

The increased capillary leakage can be linked to altered distribution in surgical patients [8].

This is observed in sepsis and mainly after major surgical stress [9].

An initial deduction in albumin production while acute phase protein synthesis increases, which is followed by a subsequent global hike in hepatic proteins synthesis including albumin [10].

The normal transcapillary escape rate for albumin increases by up to 300% in patients with septic shock, and by 100% after cardiac surgery [8]. With appropriate treatment in septic patients the transcapillary exchange rate may improvise. In patients with septic status there can be improvement in the transcapillary exchange rate if there is appropriate treatment. When there is increased flow of albumin across capillary membrane there should be increase in intravascular compartment lymphatic.

Rate of albumin synthesis is changed in postoperative patients [11]. The reduced albumin is compensated for by an increase in acute phase proteins [12]. A sustained inflammatory response in surgical patients who underwent major surgeries may cause prolonged inhibition of albumin synthesis (Figure 1).

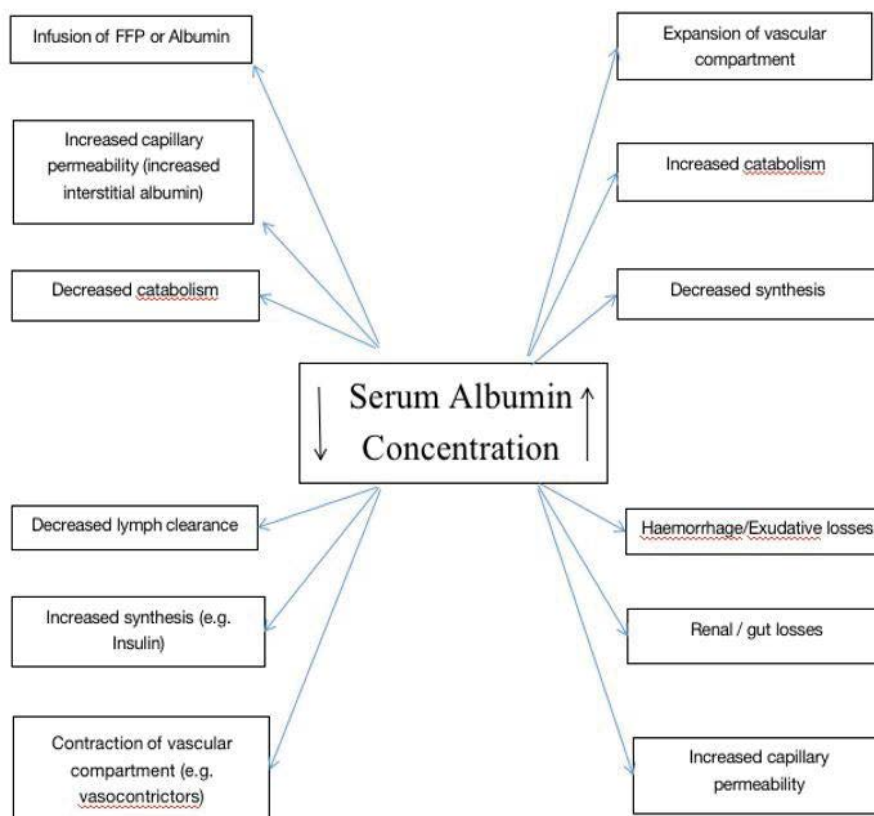


Figure 1: Chart enumerating the various factors which lead to change in serum albumin postoperatively.

Hypoalbuminemia related postoperative complications includes:
 Systemic sepsis.
 Acute renal failure.
 Coma.
 Renal insufficiency.
 Failure to wean from ventilation.
 Bleeding/transfusions.
 Cardiac arrest.
 Pneumonia.
 Urinary infections.
 Pulmonary edema.
 Reintubation.
 Deep wound infection.
 Wound dehiscence.
 Prolonged ileus.

Pulmonary embolism.
 Myocardial infarction.
 Neurological deficits.
 Superficial wound infection.
 DVT/ thrombophlebitis.
 CVA.
 Graft failure.

A systematic review of the literature has been performed for a specific search in Medline and PubMed up to June 2020. Reference lists of retrieved articles and review articles were manually searched for using the search terms “serum albumin”, “postoperative mortality and morbidity”, “hypoalbuminemia”, “length of hospital stay”, “surgical site infection (SSI)”.

Research question: The purpose of this study was to recognise the importance of serum albumin and its effect on postoperative morbidity and mortality.

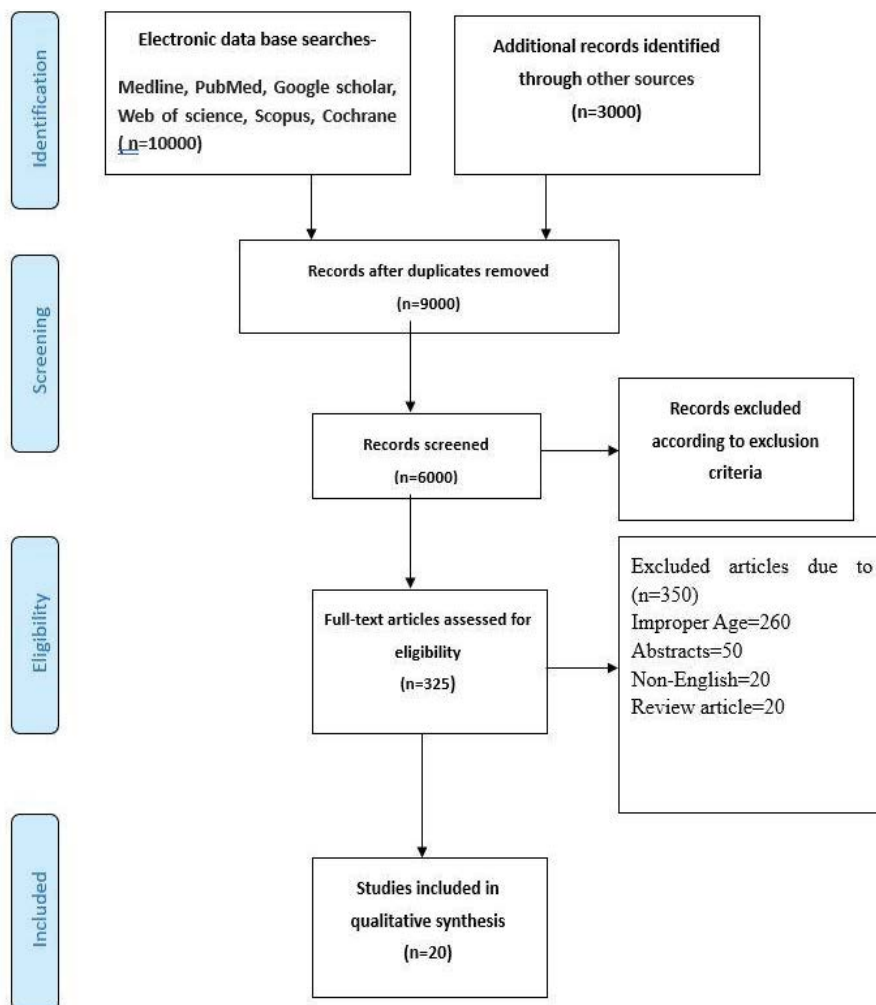


Figure 2: The PRISMA flow diagram of systematic study selection.

METHODS

Search strategy: A comprehensive set of keywords or search terms were built like hypoalbuminemia, serum albumin, postoperative morbidity, clinical postoperative mortality, nutrition, total protein. We searched MEDLINE, Scopus, Google scholar, PubMed, Web of Science, Cochrane Central Register of Controlled Trials databases and selected relevant observational studies up to June 2020. The list of reference articles was retrieved, and they were searched via automation and manually. Studies were restricted to English language and humans only. Data extraction: Data was extracted by 2 authors into separate forms on Microsoft excel 2020. Article selection and data extraction discrepancies were resolved through discussion. No publication date restriction was set. Automated and manual reduplications was performed (Figure 2).

Inclusion criteria: Those research studies were taken into consideration which (Figure 2):

Included both elective and emergency surgeries.

Included major and super major surgeries.

Included albumin transfusion pre- and post-operatively.

Age group 15-75 years of age.

Exclusion criteria: Those research studies were excluded which (Figure 2):

Had enrolled patients of age <15 years.

Had Pregnant females enrolled in the study.

Had enrolled patients of age >75 years.

DISCUSSION

To understand the importance of serum albumin in postoperative mortality and morbidity, a collective generalized analysis & outcome discussion has been done regarding studies that have compared serum albumin to surgeries carried out in emergency and elective way.

Garg et al. [13] conducted a study investigating the relationship between preoperative serum albumin and mortality following radical cystectomy (RC) and urinary diversion complications. Around 1992 and 2005 a study of 1097 RCs was carried out for the diagnosis of bladder cancer. All the details are prospectively

inserted into a problems database focused on hospital. The study concluded that low preoperative serum albumin was an important predictor of complications and post-RC mortality. Monitoring serum albumin may be used to identify individuals at elevated risk of morbidity and mortality.

Lee et al. [14] conducted a review to evaluate SSI predictors in patients undergoing significant oral or oropharyngeal squamous cell carcinoma (OSCC) surgery, and to establish the relationship between perioperative albumin and SSI growth. 337 consecutive patients who underwent OSCC, serum albumin, glucose, and hemoglobin clean-contaminated surgery were perioperatively assessed. The research found that early postoperative hypoalbuminemia is a significant risk factor for SSI in patients with carcinomas.

Hu et al. [15] performed a review to evaluate the significance of hypoalbuminemia deficiency (albumin <35 g/l) in forecasting colorectal cancer surgery-related hazards. This was a longitudinal study using multi-institutional, globally accredited American College of Surgeons (ACS-NSQIP) database to review moderate hypoalbuminemia and its effect on postoperative mortality and morbidity. Among a sample of 30,676 patients with colorectal cancer that underwent surgery, 5230 had moderate hypoalbuminemia (<35 and ≥30 g/l), and 21,310 had usual levels of albumin (≥35g/L). Significant variations between the 2 groups were observed in 21 clinical attributes. Postoperative mortality was substantially correlated with moderate hypoalbuminemia after the likelihood level. Postoperative complications like DVT, Superficial and deep wound infections, lung infections, sepsis, embolism, prolonged ventilatory support, CVA, blood transfusion and re-intubation, all of them had increased occurrence in the presence of moderate hypoalbuminemia. The research suggested that a small drop of serum albumin is leading to poor postoperative result.

Konigsbrugg et al. [16] performed an investigation in the framework of the Vienna Cancer and Thrombosis Study (CATS) in which 1,070 patients were included with active cancer and assayed serum albumin from venous blood taken at study inclusion. Risk for occurrence of VTE was calculated in a proportional

subdistribution hazard regression model with respect to competing risk of death and adjusted for cancer site, leukocyte count, estimated glomerular filtration rate, and cholinesterase. Serum albumin rates have been correlated substantially with decreased incidence of VTE and death in cancer patients.

Hennessey et al. [17] conducted a study to determine the relationship between preoperative serum albumin and SSI. A study of 524 patients who underwent gastrointestinal surgery in 4 institutions was performed. Patients were identified using a prospective SSI database and hospital records. Serum albumin was determined preoperatively in all patients. Hypoalbuminemia was defined as albumin 30 mg/dL. The study concluded that Hypoalbuminemia was an independent risk factor for the development of SSI following gastrointestinal surgery and is associated with deeper SSI and prolonged inpatient stay.

Alberti et al. [18] performed a review to evaluate the plasma albumin content following surgical trauma directly postoperatively. After balancing all the demographic status and collecting blood samples before and directly after operation, research was performed on 100 persons. Serum albumin reduced from 3.72 ± 0.47 to 2.83 ± 0.71 g / dL ($P < 0.0001$), but no disparity in age or skin tone with major surgery. With respect to age ranges, a larger decline in albumin was found in patients over 65 years of age, accompanied by younger patients (< 45 years of age), and eventually patients between 45 and 65 years of age. The study concluded that there is acute reduction in albumin concentration in immediate postoperative period and was more substantial in patients aged over 65 years of age.

Badia-Tahull et al. [19] conducted a study on the relationship between serum albumin preoperative and clinical postoperative course. Patients that underwent major elective GI surgery is considered. Comparison of postoperative clinical course with preoperative analytical parameters was made. This has been a retrospective review. Patient has been categorized according to surgical procedure. Age, serum albumin were independent variables. Morbidity, death, TPN quality, and hospital duration were contingent variables. Studied 158 patients. Preoperative hypoalbuminemia was significantly associated with higher

morbidity and longer hospital stay regardless of the type of surgery on multivariate analysis. Gastroesophageal operation was correlated with higher morbidity, mortality, parenteral nutritional requirements, and stay in hospital among the multiple procedures analyzed. It was concluded that in patients undergoing major GI surgery, preoperative albumin identification is cheap, easy and efficient research to involve patients in daily preoperative analytical workutabl.

Berbel-Franco et al. [20] conducted a study to see the prognostic role of low postoperative serum albumin levels after cardiac surgery with normal preoperative serum albumin. The study was of prospective observational type. Patients undergoing cardiac surgery with normal preoperative serum albumin and nutritional status were included and classified into different subgroups based on serum albumin levels at 24 hours after cardiac surgery. Outcomes were assessed for different subgroups. 2818 patients were included in the study. The study concluded that presence of postoperative hypoalbuminemia after cardiac surgery is frequent and degree of hypoalbuminemia may be associated with worst outcomes and longer cardiopulmonary bypass time.

CONCLUSION

Preoperative serum albumin analysis has emerged as a cheap and easy means to assess patient's nutritional status and helps in predicting postoperative morbidity and mortality. Various studies discussed above had confluence of results when it came to the statement that preoperative serum albumin plays a vital role in determining postoperative outcome in terms of postoperative recovery, length of hospital stay, chances of redo surgery, time on ventilatory support and other postoperative morbid conditions.

CONFLICT OF INTEREST

The authors state that there is no conflict of interest.

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