



The Evaluation of Albumin Use in an Iranian University Hospital

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ABSTRACT

Background: Albumin is an expensive protein colloidal solution with various indications, especially in critically ill patients. The vast use of albumin in health care centers (particularly ICUs), the theoretical danger of contaminant transmission (as with any blood derivative), and the existence of more economical alternatives of equal efficacy evidence the importance of conducting a drug-utilization evaluation. The objective of this study was to assess the usage of albumin in patients at a hospital in Iran.

Methods: Albumin administration was evaluated in 210 patients from different wards on randomly selected days during one year. Reasons for the prescription, the consumed dose, length of administration, and related laboratory tests were recorded.

Results: Albumin was prescribed inappropriately in 76.2% and appropriately in 23.8% of inpatients. The most frequent inappropriate prescribing motives were hypoalbuminemia (35.6%), nutritional support (32.5%), and edema (24.4%), while the most appropriate prescriptions were edema (46%), nephrotic syndrome (18%), and plasmapheresis (16%). The total amount of albumin used for 210 patients was 68930 g, from which 51290 g costing \$274607.1429 was administered for inappropriate indications.

Conclusion: Despite the many valid guidelines defining the appropriate indications of albumin, this study demonstrated the extensive inappropriate use of this expensive preparation in one of the largest university-affiliated hospitals in northwestern Iran. It seems advisable to have the consumption of albumin continuously monitored.

Introduction

Drug utilization evaluation (DUE) is an organized, practical, qualitative and consecutive study aimed at improving health care services. Data is collected from marketing, distribution, prescription, and consumption of a medicinal preparation with a focus on medical, social, and economical impacts. This knowledge-based practice is used to assess the appropriateness of drug therapy to provide essential information for physicians when prescribing drugs. In an age of increasing focus on clinical efficacy and control of healthcare costs, most DUEs tend to be conducted on high cost, high volume medications that may also have a narrow therapeutic window, regarding their significant clinical and economical consequences.¹⁻³

Albumin is an expensive, multifunctional, colloidal preparation with vast clinical utilizations for critically ill patients, especially in Intensive Care Units (ICUs). Although this most abundant plasma

protein has diverse functions in the body, its clinical indications are quite limited. Albumin indications have been an issue of controversy since it became commercially available in the 1940s. Its numerous theoretical and pharmacological benefits associated with rare reports of adverse effects have resulted in an excessive tendency among physicians to prescribe albumin.^{4,5} The high, worldwide rate of the inappropriate use of albumin, its high cost, limitation of availability, and difficulty of production; the theoretical risk of disease transmission (as with any blood derivative); and the existence of more economical alternatives of comparable efficacy declare that clinical and economical evaluations are imperative to determine appropriate therapies, define protocols, and establish local recommendations to narrow albumin guidelines proportional to uses in institutions.⁶ This is the first DUE of albumin in the biggest university-affiliated teaching hospital in

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northwestern Iran.

Methods

The current study was conducted at Imam Reza Hospital, Tabriz, Iran. Data collection occurred on randomly selected days between February 2015 and February 2016. Two hundred and ten patients who received albumin in different wards were included in this study. Data was collected in a designed checklist with three sections from the start of the treatment until the end. The first section collected patient demographics (age, gender, and ward), the prescribing physicians specialty, and the reason for the prescription. In the second section, details of albumin use were recorded (total amount prescribed, duration of albumin therapy, dosage or frequency). The last section recorded laboratory results such as albumin level, BUN, and SCr. Reasons for the prescription of albumin were recorded after checking patient files and consulting physicians who were delivering the health care; finally, decisions on the appropriateness of albumin administration were checked and confirmed with a senior clinical pharmacist. The indications were evaluated as appropriate or inappropriate according to the guidelines.^{6,7} Data was stored and analyzed with SPSS 16 (SPSS Inc., Chicago). The study was approved by hospital authority and the anonymity of patients and clinical data was guaranteed.

Results

Data were collected on 210 patients; patient demographics and characteristics, are presented in Table 1. The highest albumin consumption was recorded from ICUs and surgery wards (85.3%) among total 12 wards.

Table 1. Patient characteristics.

Age, year (min-max)	60.4 ± 19.6 (16-94)
Sex, Male n (%)	113 (53.8)
Diagnosis on admission, n (%)	
Cancer	41 (19.5)
Sepsis	37 (17.6)
Radical abdominal surgery	30 (14.3)
MT and GIB	20 (9.5)
CVA	20 (9.5)
Nephropathy	19 (9)
Pneumonia	14 (6.7)
Autoimmune disorders	8 (3.8)
Liver failure	8 (3.8)
Electrolytes & metabolic disorders	3 (1.4)
Others	10 (4.8)
Alb _b	2.5 ± 0.5
Alb _a	3.3 ± 0.7

MT= multiple trauma, GIB= gastrointestinal bleeding, CVA= cerebrovascular accident, Alb_b= Serum albumin before administration, Alb_a = Serum albumin after administration

*All quantitative data are indicated as Mean ± SD

Among all studied 210 albumin orders, only 23.8% of them were in concordance with valid guidelines. The total amount of albumin prescribed for 210 patients was 68930 g; of that amount, 51290 g (74.4%) was not used for appropriate indications. Mean amount per patient was 328.2 g and the mean dose/patient/day was 19.88 ± 6.81 g for the mean treatment period of 17 ± 15 days.

An overview of the appropriateness of prescriptions with respect to reasons of administration, albumin usage details, and the cost of albumin used for each reason are presented in Table 2.

All patients received albumin for only one clinical indication. The most frequent indication for albumin use was edema comprising 62 (29.5%) patients, followed by hypoalbuminemia in 57 patients (27.1%) and nutrition support in 52 cases (24.8%).

Among the 10 reasons for albumin prescription, albumin therapy was appropriate in 100% of cases of nephrotic syndrome, liver failure and hepatic resection, plasmapheresis, and ARDS. The inappropriate use of albumin occurred most frequently for hypoalbuminemia, nutrition support, edema, and plural effusion which represented 57 (100% of prescriptions), 52 (100%), 39 (62.9%), and 9 (100%) patients, respectively, who received albumin for incorrect reasons.

The cost of one vial of albumin was \$53.6, resulting in an overall cost of \$369,268. Of this amount, \$274,607 was spent on inappropriate treatment.

Discussion

In line with our results, several studies that have investigated albumin utilization in different centers around the world have revealed a high rate of unjustified albumin use based on reliable guidelines. Inappropriate albumin utilization causes a great waste of funds and increases the probability of adverse effects. DUEs help determine albumin utilization patterns of the in institutions, and their results could be used to help physicians modify their practices.

With respect to the close relationship between albumin and colloidal oncotic pressure, hypoalbuminemia could be the initiator of edema or may cause it to develop.⁸ In addition, a normal albumin level prevents the development of edema, providing a balance between hydrostatic and colloid osmotic pressure within vessels.⁹ So, it is believed that albumin, featuring water-retention and diuretic properties, can be used to treat edema associated with hypoalbuminemia.^{10,11} Although there is undoubtedly some association between edema and low serum albumin, there are many confounding factors which affect the relationship.⁸

Table 2. Albumin utilization reasons and Evaluation of its use.

Indications	Albumin use			Daily dose ^a (g/d)	Duration ^a (d)	Total cost \$ (inappropriate use cost) ^c
	Prescriptions (%)	Inappropriate use (% ^b)	Total (g)			
Edema	62 (29.5)	39 (62.9)	17990	18.2 ± 6.5	16.9 ± 15.7	96375 (53411)
Hypoalbuminemia	57 (27.1)	57 (100)	19880	18.8 ± 7.3	18.9 ± 17.2	106500 (106500)
Nutritional support	52 (24.8)	52 (100)	17210	22.9 ± 5.8	15.2 ± 12.9	92196 (92196)
Nephrotic syndrom	9 (4.3)	0 (0)	2950	18.8 ± 6	11.4 ± 3.7	15804
Pleural effusion	9 (4.3)	9 (100)	3760	18.1 ± 6.3	26.6 ± 14.3	20143 (20143)
Plasmapheresis	8 (3.8)	0 (0)	3120	22.5 ± 4.62	22.4 ± 25.8	16714029
liver failure and hepatic resection	4 (1.9)	0 (0)	1330	26.7 ± 3.9	14.2 ± 6.3	7125 (0)
Paracentesis	4 (1.9)	2 (50)	370	20 ± 1.1	4.2 ± 3.9	1982 (1768)
ARDS	3 (1.4)	0 (0)	930	13.3 ± 5.8	18.3 ± 16.2	4982 (0)
Shock and dehydration and alkalosis	2 (1)	1 (50)	1440	23 ± 4.2	34 ± 38.1	7714 (589)

^a Mean ± SD^b The percentage of inappropriate use of total prescriptions with each reason^c Total cost presented as dollar

Opponents to the belief mentioned above emphasize the temporary beneficial effect of albumin in drawing fluid out of the interstitium into the intravascular space. A few minutes after administration, albumin escapes from the capillary into the interstitium; if it is unable to be cleared, it will retain additional fluid, leading to further edema.⁸ In conclusion, from 62 edematous patients, 23 cases, whose serum albumin concentrations were < 2 g/dl, were considered to have received appropriate administration, since albumin could improve conditions of these severe hypoalbuminemic patients for future treatment.

In this study, one of the most frequent inappropriate reasons for albumin administration was hypoalbuminemia, which accounted for 57 prescriptions (27.1%) (see Table 2). Hypoalbuminemia is defined as a serum albumin concentration < 3.5-4 g/dl and is associated with diverse pathological conditions.⁹ It has been shown that hypoalbuminemia is associated with poor outcomes in critically ill patients.^{9,12} Nevertheless, several studies have demonstrated that albumin administration in hypoalbuminemic patients had no distinctive effect on mortality or morbidity.¹² Thus, in many guidelines, decreased serum albumin concentration as a sole diagnosis is not considered a sufficient reason for albumin replacement. A useful practice for these patients is to identify and

treat the underlying causes of the hypoalbuminemia.^{6,11} Conversely, there are some guidelines that indicate albumin can be prescribed only in cases where the serum albumin level is less than 2.5g/dl.¹² In the current study, a total of 57 patients receiving albumin infusions just for hypoalbuminemia were considered to have been inappropriately treated. From all studied hypoalbuminemic patients, 15 cases with albumin levels between 2-2.5 g/dl, 13 cases with albumin levels >2.5 g/dl, and 29 patients with albumin levels >3.5 g/dl received albumin infusion just to prevent the possibility of developing hypoalbuminemia.

Nutritional support is another irrational indication of albumin usage to which different protocols and clinicians have contradictory approaches. In general, the correct treatment for malnourished patients is oral, enteral, and/or parenteral nutrition with amino acids and adequate calories to improve imbalances between the rates of albumin synthesis and metabolism; in some cases, however, albumin is used as a caloric protein source, especially for malnourished patients. Iatrogenic elevation of serum albumin levels above 4g/dl that may happen in albumin therapy for these patients will increase the overall catabolism rate and result in inverse effects. Some protocols indicate that albumin could be recommended for malnourished patients if: there

is severe diarrhea (>2 l/day), serum albumin concentration <2 g/dl, diarrhea has not been cured by short-chain peptides or elemental formulas, and other reasons for diarrhea have been excluded.^{11,12}

None of the 52 patients in this study met these criteria, yet physicians prescribed albumin.

The importance of DUEs is to illustrate the patterns of albumin utilization of different institutions, and thereby, future approaches to decision-making will be obtained. This study demonstrated a high incidence of unacceptable use of albumin (76.2% inappropriate prescriptions) based on guidelines and great futile expenditures (about \$274,607 for 210 patients). Therefore, it can be concluded that more attention should be given to developing and implementing the guidelines for albumin use.

The distribution of local recommendations that have been developed by clinical pharmacists and specialists, particularly those responsible for the most frequent prescriptions, could help improve health services and reduce expenditures. These pre-assessed criteria will increase the tendency of clinicians to obey them in their practices. Moreover, training workshops for physicians on how to use these criteria and elucidating the most problematic inappropriate reasons for prescriptions seems essential. Other processes that could be considered and implemented to cut back on albumin use and reduce health care costs related to albumin include setting up an expiration date for recommendations so they are updated with the latest scientific findings, preparing checklists and surveys to remind physicians of the criteria for prescribing albumin, maintaining the presence of pharmacists to advise on prescribing and following the drug therapy and performing other multicenter DUEs at regular intervals with larger sample sizes.

Conclusion

Since the results of Cochran meta-analyses in 1998 showed increased mortality in critical patients from albumin administration in comparison to crystalloid solutions,¹³ the attention of clinicians and researchers has been drawn to the use and indications of albumin. A great number of studies and clinical trials were conducted, and some valid guidelines have been established so far. Despite the presence of these reliable guidelines and advanced science on albumin issues, albumin is surprisingly still being used for inappropriate indications as demonstrated by this study.

Conflict of interests

The authors claim that there is no conflict of interest.

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