International Journal of Contemporary Pediatrics
Takrani KG et al. Int J Contemp Pediatr. 2022 Apr;9(4):371-375
http://www.ijpediatrics.com
pISSN 2349-3283 | eISSN 2349-3291

DOI: https://dx.doi.org/10.18203/2349-3291.ijcp20220764

Original Research Article

Study of hypoalbuminemia in paediatric intensive care unit admitted children

Kishan G. Takrani*, Suhas G. Kumbhar

Department of Paediatrics, Bharati Vidyapeeth (Deemed to be University) Medical College and Hospital, Sangli, Maharashtra, India

Received: 25 February 2022
Revised: 15 March 2022
Accepted: 21 March 2022

***Correspondence:**
Dr. Kishan G. Takrani,
E-mail: ktakrani1239876@gmail.com

ABSTRACT

Background: Albumin has several important properties in both health and disease. Hypoalbuminemia has been considered as an indicator of disease severity and mortality in adult patients, but its role in pediatric patients is not well established. Study aimed to understand importance of hypoalbuminemia in critical illness in paediatric patients.
Methods: This was a cross-sectional study conducted amongst children aged 2 months to 18 years admitted at PICU of a tertiary care hospital over a period of 6 months. Study protocol was approved by institutional ethical committee.
Results: Amongst the total studied cases (110), 59 cases of the total contributed to hypoalbuminemia. According to primary system affected, post COVID MISC, acute infectious diseases, systemic inflammatory disease and sepsis are some of the common conditions associated with higher incidence of hypoalbuminemia. Statistically significant difference was found in this group of population. Amongst the hypo-albuminemic group 59 (53.64%), in mild category there were 42 (38.18%) patients and in severe category there were 17 patients (15.46%).
Conclusions: Hypoalbuminemia is common in patients admitted to the PICU. Post COVID MISC, acute infectious diseases, sepsis and systemic inflammatory diseases are most common conditions associated with it. Hypo-albuminemiais an important indicator of mortality in PICU and serum albumin is a good and reliable indicator for detecting mortality.

Keywords: Hypoalbuminemia, Serum albumin level, Mortality, Critically ill children, Post COVID MISC, Sepsis, Systemic inflammatory disease

INTRODUCTION

Albumin is synthesized in liver and constitutes more than 50% of total plasma proteins, and is responsible for the transport and binding of many molecules.[1] It contributes to 80% of the regulation of blood volume. About two thirds of albumin resides mainly in the extravascular space. Critical illness alters the rate of synthesis and degradation of albumin as well as its distribution between the intravascular and extravascular compartments[2]. Altered distributions in critical illness is related to increase in capillary permeability. Inflammatory disorders can accelerate the catabolism of albumin, while simultaneously decreasing its production.[3,4] Predicting the prognosis of patients in intensive care unit (ICU) is important for evaluating the quality of ICU, and making decisions regarding further management. The accurate methods of predicting outcome of patients have been needed, therefore many scoring systems for predicting prognosis including mortality of patients have been proposed. However, predicting the prognosis of critically ill patients whose condition fluctuates every other moments is challenging[5]. Therefore, it is necessary to identify non-invasive, easy means to predict the prognosis of the patients in ICU, especially for paediatric patients. In the present study, we aimed to study the

frequency of hypoalbuminemia, various conditions associated with it and to also study grading of hypoalbuminemia in Paediatric Intensive care unit (PICU) admitted children.

METHODS

Study design and sample population

This cross-sectional study was conducted amongst children aged 2 months to 18 years admitted at PICU at Bharati Vidyapeeth (Deemed to be university) medical college and hospital over a period of 6 months (November 2020-April 2021). All the patients aged 2 months to 18 years of age admitted to PICU during the period of 6 months (November 2020-April 2021) were included in the study by convenience (non-random) sampling method. The study protocol was approved by institutional ethical committee.

The objectives of the study were-To study the frequency of hypoalbuminemia in PICU admitted children, to study the various conditions associated with hypoalbuminemia and to study the grading of hypoalbuminemia in PICU admitted children.

All patients aged 2 months to 18 years of age admitted to PICU and admitted for at-least 24 hours were included in the study. Hypoalbuminemia was defined as a serum albumin level of less than 3.5 g/dl for patients and amongst them in mild category were categorised children with serum albumin level between 2.5-3.5 mg/dl and in marked category included children with serum albumin level below 2.5 mg/dl. Patients who were not expected to have a normal albumin level in their usual state of health were excluded.[6-8]

This included: patients who had severe protein energy malnutrition(weight for height-3 standard deviations), chronic liver disease and liver cirrhosis, nephrotic syndrome and nephritis, presence of chronic gastrointestinal or kidney disease affecting the growth (malabsorbtion syndrome, celiac disease, inflammatory bowel disease, chronic renal failure), reciept of parenteral nutrition before admission, second or third degree burns and patients who received albumin or blood products before measuring the albumin level.

Data collection and analysis

All the pediatric intensive care unit admitted children and fulfilling the above-mentioned criteria were studied in detail. Detailed evaluation was done in relation to relevant history, general examination and systemic examination. Above data was documented on a pre-structured proforma, following which a provisional diagnosis was made and the necessary investigations including basic and some special investigations was carried out and this data was also recorded in the proforma. Serum albumin level was done in all patients on the day of hospital admission. Depending upon the Serum Albumin level, it was categorised into mild and marked hypoalbuminemia. Then depending upon the frequency of hypoalbuminemia, according to primary system affected and grading of serum albumin level, the data was recorded and interpreted. Clinical course in the hospital in terms of length of hospital stay, use of inotropes and whether on mechanical ventilator was also entered in proforma. Outcome in term of death and discharge was also documented.

Statistical analysis

The data was compiled and entered in SPSS version 23 for statistical analysis. Data was studied in detailed in two group of population, amongst the normoalbuminemic group and hypoalbuminemic group. Amongst the Hypoalbuminemic group it was further classified into mild and marked category to study the further outcome. Then analysis was performed using chi square/Fisher's exact test, considering $p<0.05$ as statistically significant.

RESULTS

Two hundred twenty-two (222) were the total number of patients included. One hundred ten (110) were the final number of included patients eligible for the study and analysis as shown in Figure 1.[9] In the total of 110 cases in the present study, Patients aged between 1 month-5years of age comprised 54.55% (n=60) of total patients accounting for the maximum number amongst all, 6^{th}-12^{th} year of age were 24.55% (n=27) and 13^{th}-18^{th} year of age were 20.90% (n=23) respectively as shown in Table no 1. In the total of 110 cases, 64 were males and 46 were females constituting 58.18% and 41.81% of the total cases respectively as shown in Table 1.[10,11] The most common presenting symptom amongst patients admitted in PICU was fever (70.90%) followed by vomiting present in 51.81% of children. Convulsion, breathlessness and abdominal pain were some of the other symptoms observed in 28.18%, 27.27% and 23.63% of children respectively. Similarly, generalized edema was one of the most common signs observed present in 42.72% (47) of children. Hepatomegaly being present in 35.45% of children. Hypotension and Ascites being present in 38.18% and 22.72% of the children as shown in Table 1. It was observed that amongst the total studied cases (n=110), there were 59 patients (53.64%) with low albumin level (hypoalbuminemia) and 51 patients (46.36%) with normal albumin level. After complete workup of the patients and detailed analysis, it was found that no of patients with acute infectious diseases, post COVID MISC, systemic inflammatory disease and Sepsis were significantly higher inhypoalbuminemic group as compared to normoalbuminemic group and statistically significant difference was also noted in this group. Out of the total studied cases, 101 were discharged and death was noted in 09 cases constituting 98.12% and 8.18% respectively. To compare outcome between two groups of patients it was noted that number of deaths were

significantly higher in hypo-albuminemic group (13.56%) than deaths in normoalbuminemic group (1.2%) (p=0.03) and more specifically comparing out-come according to grading of hypoalbuminemic patients it was noted that number of deaths were significantly higher in marked hypoalbuminemic group (35.29%) than deaths in mild hypoalbuminemic group (4.55%) (p=0.002).

Table 1: Baseline characteristics of the patients included in the study.

Variables	Numbers	Percentages (%)
Age group (Years)		
1 month-5	60	54.55
6^{th} -12	27	24.55
13^{th} -18	23	20.90
Gender		
Male	64	58.18
Female	46	41.81
Presenting symptoms		
Fever	78	70.90
Cough	21	19.09
Breathlessness	30	27.27
Vomiting	57	51.81
Abdominal pain	26	23.63
Loose stools	20	18.18
Oliguria/polyuria	03	2.7
Headache	13	11.81
Convulsion	31	28.18
Altered sensorium	11	10
Other significant complaints	65	59.09
Presenting signs		
Poor sensorium	18	16.36
Fever	51	46.36
Hypotension	42	38.18
Hypertension	03	2.7
Signs of shock	42	38.18
Pallor	31	28.18
Generalised edema	47	42.72
Ascites	25	22.72
Erythematous rash	30	27.27
Hepatomegaly	39	35.45

Table 2: Frequency of hypoalbuminemia among study cases.

Variables	Total no. of cases, (n=110)
Total no. of patients included in study	110
Total no. of patients with normal albumin levels	51 (46.36)
Total no. of patients with low albumin levels	59 (53.64)

Table 3: Demonstrating conditions associated with hypoalbuminemia among study cases according to primary system affected.

Primary system affected	Hypoalbuminemic group, (n=58)		Normoalbuminemic group, (n=52)		P value
	N	%	N	%	
Acute infectious disease	18	30.51	04	7.84	0.0037
Post COVID MISC	10	16.95	01	1.96	0.01
Cardiovascular system	03	5.08	03	5.88	1
Hematology	03	5.08	04	7.84	1
Central nervous system	04	6.78	20	39.22	<0.0001
Systemic inflammatory disease	06	10.17	00	-	0.02

Continued.

Primary system affected	Hypoalbuminemic group, (n=58)		Normoalbuminemic group, (n=52)		P value
	N	%	N	%	
Respiratory tract infections	00	0.00	04	7.84	0.0433
Sepsis	09	15.25	02	3.92	0.05
Metabolic	01	1.69	01	1.96	1
Others (Poisoning and envenomation, trauma and surgical conditions)	05	8.47	12	23.53	0.03

Table 4: Demonstrating grading of hypoalbuminemia among study cases.

Grading of hypoalbuminemia	Total no. of cases, (n=110) (%)
Normal albumin levels (>3.5 mg/dl)	51 (46.36)
Mild hypoalbuminemia (2.5-3.5 mg/dl)	42 (38.18)
Marked hypoalbuminemia (<2.5 mg/dl)	17 (15.46)

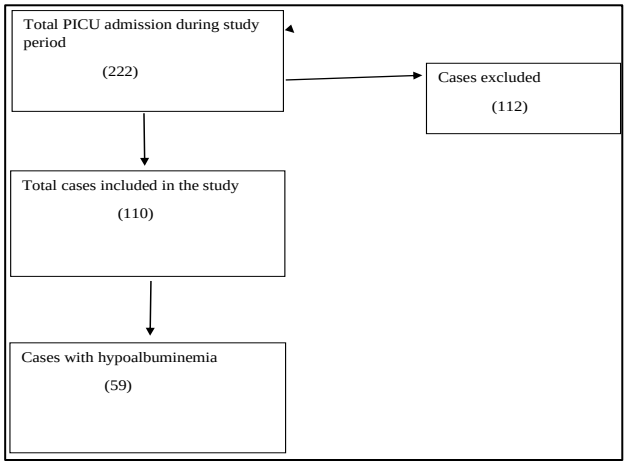

Figure 1: The study case.

DISCUSSION

The present study was done to study the frequency of hypoalbuminemia in PICU patients, to identify the primary system associated with hypoalbuminemia and for grading of hypoalbuminemia.

In our study, prevalence of hypoalbuminemia amongst study cases was 53.63%. In a similar study conducted by Deka et al prevalence of hypoalbuminemia was present in 38% of total cases. Study conducted by Deka et al reported hypoalbuminemia being found in one third of the patients which was consistent with the studies conducted by Horowitz and Tai and Tiwari et al. This data is similar to many previous studies which have revealed prevalence of hypoalbuminemia being 33%-57%. This might be contributed to the differences in the study population and definition of hypoalbuminemia used in different studies. In the present study, out of total 110 study subjects, 54.55 % of the m were in the age group of 1stmon-5 years, 24.55% in the age group 6th -12 years and 20.90% in the age group 13th-18 years. It was observed that amongst study subjects, 58.18% were males and 41.82% were females. The male to female ratio was 1.4:1. In a similar study conducted by Tiwari et al male to female ratio was 2.44:1.[10,11]

In the present study, the most common presenting symptom amongst patients admitted in PICU was fever (70.90%) followed by vomiting present in 51.81% of children. Convulsion, breathlessness and abdominal pain were some of the other symptoms observed in 28.18%, 27.27% and 23.63% of children respectively. Similarly, generalized edema was one of the most common sign observed in 42.72% (47) of children. Hepatomegaly being present in 35.45% of children. Hypotension and Ascites being present in 38.18% and 22.72% of children. It was observed that amongst the total studied cases (n=110), there were 59 patients (53.64%) with low albumin level and 51 patients (46.36%) with normal albumin level. In a similar study, conducted by Yanni et al of 68 subjects in the PICU, there were 33 patients with hypoalbuminemia (48.5%) and 35 (51.4%) with normal albumin level.[12] In our study hypoalbuminemia was defined as albumin level of less than 3.5 mg/dl, further divided as mild hypolbuminemia with albumin level less than 3.5 mg/dl and marked hypoalbuminemia with albumin level less than 2.5 mg/dl. In a similar study conducted by Tiwari et al defined hypoalbuminemia as a serum albumin level lower than 2.5 mg/dl while Durward et al defined it as lower than 3.3mg/dl.[13] Leite P et al in his study defined hypoalbuminemia as less than 3.5 g/dl.

In our study according to primary system affected, post COVID MISC, acute infectious diseases, systemic inflammatory disease and Sepsis are some of the common conditions associated with higher incidence of hypoalbuminemia. Statistically significant difference ($p<0.05$) was found in this group of population. In a study conducted by Deka et al large number of cases with sepsis were significantly associated with hypoalbuminemia being similar as in our study. In a study conducted by Kumar et al infectious diseases accounted for a large number of cases associated with hypoalbuminemia.[11,12]

In our study, number of deaths were significantly higher in hypo-albuminemic group (13.56%) than deaths in Normo-albuminemic group (1.2%). In a similar study conducted by Golhar et al mortality rate amongst hypoalbuminemic group was high corresponding to 32.5% (26 out of 80). In a similar study conducted by

Tiwari et al a similar pattern of fatal outcome was noted in this group of population. In a similar study conducted by Moustafa et al 36.36% of patients with hypoalbuminemia died which was consistent with Kumar et al as they report mortality of 32%. In a similar study conducted by Deka et al children with hypoalbuminemia had a mortality rate of 31.5% (12 out of 38) which was 2.2 times greater than the normal albumin level, i.e.,14.5 (9 out of 62).[11,13]

There were few limitation of the study: Short duration of study period and no clear definition of hypoalbuminemia. Hence the true prevalence of hypoalbuminemia is difficult to compare directly.

CONCLUSION

Hypoalbuminemia is common in patients admitted to the PICU. In the past decade, the research on albumin for the clinical treatment of critically ill patients has certainly yielded important information aiding more appropriate use of this product. Apart from its oncotic properties, albumin has many secondary functions which may play a critical role and have a great impact on different type of diseases. Post COVID MISC, acute infectious diseases, sepsis and systemic inflammatory diseases are most common conditions associated with it. Hypoalbuminemiais an important indicator of mortality in PICU and serum albumin is a good, simple, sensitive, specific, easily available and low-cost assay and can be used as an early discriminator for detecting prognosis and outcome in critically ill patients.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Kumar S, Arror S, Kini PG, Mundkur S, Moideen A. Hypoalbuminemia as a marker of adverse outcome in children admitted to pediatric intensive care unit. Indian J Child Health. 2017;1-5.
2. Tiwari LK, Singhi S, Jayashree M, Baranwal AK, Bansal A. Hypoalbuminemia in critically sick children. Indian J Cri Care Med. 2014;18(9):565-9.
3. Kim YS, Sol IS, Kim MJ, Kim SY, Kim JD, Kim YH et al. Serum Albumin as a biomarker of poor prognosis in the Pediatric Patients in Intensive Care Unit. Korean J Crit Care Med. 2017;32(4):347-55.
4. Durward A, Mayer A, Skellet S. Hypoalbuminemia in critically ill children: incidence, prognosis and influence on the anion gap. Arch Disease Childhood. 2003;88(5):419-22.
5. Yap FH, Joynt GM, Buckley TA, Wong EL. Association of serum albumin concentrations and mortality risk in critically ill patients. Ana Intensive care. 2002;30(2):202-7.
6. Kittisakmontri K, Reungrongrat S, Lao-Araya M. Hypoalbuminemia at admission predicts the poor outcome in critically ill children. Anaesthesiol Intensive Therapy. 2016;48(3),158-61.
7. Horowitz IN, Tai K. Hypoalbuminemia in critically ill children. Arch Pediatr Adoles Med. 2007;161(11):1048-1052.
8. Jellinge ME, Henriksen DP, Hallas P, Brabrand M, Hypoalbuminemia is a strong predictor of 30 day all-cause mortality in acutely admitted medical patients. A Prospective, Observational, Cohort study. Plos One. 2014;9(8):e105983.
9. Akirov A, Masri-Iraqi H, Atamna A, Shimon I. Low Albumin Levels are associated with Mortality Risk in Hospitalised Patients. Am J Med. 2019;130(12):1465.e11-9.
10. Moustafa AA, Halawany ASA, Rafa MF. Evaluation of hypoalbuminemia as a predictor of clinical outcome in critically ill children in Alexandria University Children's hospital. J Med Sci Clin Res. 2018;6(1):32299-306.
11. Deka A, Debnath S K, Teronpi I, Ganguly A. Study on the prevalence of hypoalbuminemia and their clinical outcome in critically ill children admitted to PICU in tertiary care hospital. J Med Sci Clin Res. 2020;8(1):862-7.
12. Yanni GN, Lubis M, Ali M. The Influence of Albumin level in Critically Ill Children to Length of Stay and Mortality in Pediatric Intensive Care Unit. Open access Macedo J Med Sci. 2019;7(20):3455-8.
13. Nicholson JP, Wolmarans MR, Park GR. The role of albumin in critical illness. British Journal of Anaethesia. 2000;85(4):599-610.
14. Soeters PB, Wolfe RR, Shenkin A. Hypoalbuminemia: Pathogenesis and Clinical significance. J Parenteral enteral nutr. 2019;43((2):181-9.
15. Caironi P, Gattinoni L. The clinical use of albumin: the point view of specialist in intensive care. Blood transfusion. Transfusion del Sangue. 2009;7(4):259-67.

Cite this article as: Takrani KG, Kumbhar SG. Study of hypoalbuminemia in paediatric intensive care unit admitted children. Int J Contemp Pediatr 2022;9:371-5.