


Serum Albumin in Critical Care in Cameroon: A Critical Synthesis of Its Prognostic Value and Its Role in Risk Stratification in Critically Ill Patients

Ferdinand Ndom Ntock^{1,2*} , Stéphane Kona^{3,4}, Jonathan Essoh⁵, Willy Bilogui², Roddy Stephan Bengono⁴, Gérard Beyiha², Paul Owono Etoundi^{4,6}, Junette Arlette Metogo Mbengono^{1,2,4}

¹Department of Anesthesiology and Critical Care, Douala General Hospital, Faculty of Medicine and Pharmaceutical Sciences, University of Douala, Douala, Cameroon

²Faculty of Medicine and Pharmaceutical Sciences, University of Douala, Douala, Cameroon

³Department of Anesthesiology and Critical Care, Yaoundé Military Hospital, Douala, Cameroon

⁴Faculty of Medicine and Biomedical Sciences, University of Yaoundé I, Yaoundé, Cameroon

⁵Department of Anesthesiology and Critical Care, Laquintinie Hospital of Douala, Douala, Cameroon

⁶Department of Anesthesiology and Critical Care, Yaoundé Central Hospital, Yaoundé, Cameroon

Email: *ferdilous@yahoo.fr

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Abstract

Background: Hypoalbuminemia is common in critically ill patients and is consistently associated with adverse outcomes, including mortality, complications, and prolonged length of stay. Its interpretation remains challenging because serum albumin levels are influenced by inflammation, increased capillary permeability, and hemodilution. **Objective:** To provide a critical narrative synthesis of the role of serum albumin as a prognostic marker rather than a therapeutic target, and to discuss its potential value for frugal risk stratification in critical care in Cameroon. **Methods:** This narrative review was based on a targeted literature search (PubMed/PMC and DOI.org) and a reasoned selection of pivotal randomized controlled trials, meta-analyses, and international guidelines, complemented by the limited, published, and verifiable Cameroonian data. The approach was deliberately non-exhaustive and did not follow a systematic review protocol. **Results:** Serum albumin emerges as a robust prognostic marker, showing a dose-response association with outcomes and acting as a signal for the risk of acute kidney injury. Major randomized controlled trials in critical care do not support a universal strategy of albumin

“correction” (SAFE, ALBIOS). A signal of increased mortality has been reported in traumatic brain injury when albumin is used as a resuscitation fluid. In the Cameroonian setting, the possible coexistence of low baseline albumin levels related to undernutrition and acute decreases driven by inflammation supports a contextualized interpretation integrated with clinical indices of organ dysfunction. **Conclusion:** Serum albumin represents a potentially relevant and frugal prognostic stratification tool in Cameroon, provided that prospective local validation is performed and that its interpretation remains physiopathologically cautious; it should not, on its own, dictate therapeutic strategies.

Keywords

Hypoalbuminemia, Prognosis, Critical Care, Sepsis, Cameroon, Risk Stratification

1. Introduction

In critical care, hypoalbuminemia is extremely common and is repeatedly associated with an increased risk of complications and mortality [1] [2]. However, albumin is also a therapeutic product used for volume expansion or as a hyperoncotic solution, which sustains a persistent ambiguity: should serum albumin be interpreted primarily as a prognostic marker of disease severity and patient frailty, or as a target for correction? Available randomized controlled trials have not demonstrated a consistent benefit on major clinical outcomes, particularly mortality, when albumin is administered broadly or guided by biological targets [3] [4].

From a clinical perspective, distinguishing between a prognostic marker and a therapeutic target has concrete implications, including prioritization during initial assessment, interpretation of laboratory profiles in the context of fluid resuscitation, identification of high-risk patients, and the prevention of potentially harmful situations in which albumin administration may be deleterious, such as traumatic brain injury [5]. From a scientific standpoint, serum albumin represents an “integrative” biomarker influenced by inflammation, capillary permeability, and fluid balance, making it a plausible candidate to refine risk stratification, but also a source of ongoing methodological controversies related to confounding, causality, and dilutional effects [6]-[8].

The objective of this review is to provide a critical narrative synthesis of the available evidence on: 1) the prognostic value of serum albumin in critically ill patients [1] [2]; 2) the gap between prognostic association and demonstrated clinical benefit of albumin administration strategies in critical care [3] [4]; and 3) the manner in which serum albumin might, on an exploratory basis, be integrated into a comprehensive clinical assessment of severity, without replacing established

clinical determinants and severity scores guiding patient management.

2. Context and Rationale

In critical care, measurement of serum albumin is often available even in resource-constrained settings, as it relies on relatively standardized biochemical assays. The key issue, therefore, is not so much whether serum albumin can be measured, but rather how it should be interpreted and used at the bedside.

In Cameroon, published critical care data remain limited and heterogeneous; nevertheless, hospital-based series report high mortality rates and a substantial burden of acute conditions, making any simple, reproducible, and frugal approach to risk stratification particularly attractive [9].

In parallel, hospital undernutrition has been documented at the Douala General Hospital (Department of Internal Medicine), with lower serum albumin levels observed in undernourished patients, suggesting that a low baseline albumin concentration may be present in a proportion of admitted patients [10]. This reality further complicates the interpretation of admission serum albumin levels in the ICU, raising the question of whether they reflect acute disease severity, underlying patient vulnerability, or a combination of both.

3. Methods of the Narrative Synthesis

3.1. Source Identification Strategy

A targeted, non-systematic literature search was conducted using PubMed/PMC and DOI.org to identify studies considered structurally relevant to the research question. The search focused primarily on pivotal randomized controlled trials evaluating albumin use in critical care, notably the SAFE and ALBIOS trials [3] [4]. It also included recent meta-analyses and narrative syntheses addressing the role of albumin in sepsis and septic shock, including hyperoncotic formulations [11] [12]. International guidelines particularly those from the *Surviving Sepsis Campaign 2021* [13] as well as guidelines specifically dedicated to intravenous albumin administration [14], were reviewed. Finally, data from the Cameroonian literature related to critical care and the local hospital context were sought and included when available [9] [10].

The search terms used included, but were not limited to, the following: *albumin*, *hypoalbuminemia*, *critical care*, *ICU*, *sepsis*, *septic shock*, *traumatic brain injury*, *Cameroon*, and *Africa*.

3.2. Selection Criteria and Rationale

Source selection prioritized studies with a high level of evidence, particularly randomized controlled trials, meta-analyses, and guidelines issued by scientific societies. Older studies considered foundational were also included when their role in shaping current understanding of mechanisms, controversies, or therapeutic strategies related to albumin was recognized, including certain pivotal trials and

historical conceptual frameworks [1] [15] [3] [4].

3.3. Acknowledged Epistemological Limitations

This approach was deliberately non-exhaustive, thereby exposing the synthesis to an inherent risk of selection bias typical of narrative reviews. In addition, the transferability of data derived from international studies to the Cameroonian context cannot be assumed to be automatic. Accordingly, the practical propositions advanced in this synthesis should be interpreted as exploratory and hypothesis-generating rather than as normative recommendations, pending prospective validation in local cohorts.

4. Conceptual Framework: Biological Significance and Limitations of Albumin

Albumin as an Integrative Marker of Severity Rather Than a Nutritional Marker

Clinical nutrition societies emphasize that so-called “visceral proteins” (albumin, prealbumin, transferrin) are strongly influenced by inflammation and fluid redistribution and should not be used in isolation to diagnose malnutrition [6]. Converging reviews support the view that serum albumin is more accurately interpreted as a marker of disease severity than as a short-term indicator of nutritional status [7].

4.1. Kinetics: Why Albumin often Reflects more than Acute Dilution

The biological half-life of circulating albumin is approximately 19 - 20 days, supporting the notion that hypoalbuminemia may reflect baseline vulnerability and/or sustained inflammation, in addition to acute care-related variations [16]. This kinetic property does not preclude rapid changes in settings characterized by capillary leak, hemodilution, or fluid redistribution.

4.2. Why Does Albumin Decrease in Critical Care?

In critically ill patients, decreased serum albumin levels are primarily related to: 1) the acute inflammatory response, as albumin is a negative acute-phase protein [6]; 2) increased capillary permeability and leakage into the interstitial space, particularly pronounced in sepsis [8]; 3) iatrogenic effects, including fluid resuscitation, transfusions, and fluid overload, leading to dilutional decreases; and 4) hepatic dysfunction or hypoperfusion, which may impair albumin synthesis.

4.3. Albumin Function and Theoretical Interest in Critical Care

Albumin contributes to oncotic pressure, serves as a carrier for endogenous and exogenous molecules, and exhibits biological properties including buffering capacity, antioxidant effects, and potential interactions with the endothelial glycocalyx described in mechanistic reviews [8]. However, physiological plausibility does not equate to hard clinical benefit; the persistent gap between observed phys-

iological effects (e.g., blood pressure, fluid balance) and mortality outcomes remains central to the interpretation of clinical trials.

5. Prognostic Data: Relationship between Serum Albumin and Morbidity-Mortality

5.1. Strength and Consistency of the Association

A landmark meta-analysis demonstrated a robust association between hypoalbuminemia and adverse outcomes in acutely ill patients [1]. With respect to renal function, an observational meta-analysis reported an association between hypoalbuminemia and an increased risk of acute kidney injury [2].

Together, these findings support the interpretation of serum albumin as an indicator of disease severity and patient vulnerability rather than as an isolated therapeutic target to be corrected [1] [2].

5.2. Incremental Prognostic Value: A Key Question

In clinical practice, the question is not only whether albumin is associated with prognosis, but whether it provides useful information beyond clinical assessment and organ dysfunction scores. In this review, the proposed approach is deliberately qualitative: serum albumin is considered a risk modifier integrated into a constellation of indices (e.g., SOFA score, hemodynamic dynamics, and lactate levels when available), rather than as an isolated determinant. The levels of evidence contrasting prognostic use with interventional data are summarized in **Table 1**.

Table 1. Levels of evidence: prognostic serum albumin versus therapeutic albumin.

Clinical issue	Predominant data type	Key message	Major limitations
Serum albumin and mortality/complications	Observational studies + observational meta-analyses [1] [2]	Strong and reproducible association	Confounding by severity, dilutional effects, comorbidities, and selection bias
Albumin as a universal treatment	SAFE/ALBIOS randomized controlled trials [3] [4]	No consistent mortality benefit (primary analysis)	Observed physiological effects do not necessarily translate into hard clinical benefit
Albumin in subgroups (septic shock)	Recent meta-analyses [11] [12]	Possible signal in selected subgroups	Heterogeneity and variable quality of evidence

5.3. Contribution of Serum Albumin to Risk Stratification as a Modulating Biomarker

Within a pragmatic framework, serum albumin may be viewed as a risk modifier that enriches prognostic information beyond clinical variables alone. A historical example is provided by the SAFE trial analysis, which explored the interaction between baseline serum albumin levels and the effect of fluid type (albumin versus saline) without demonstrating a major interaction on primary outcomes [15]. This suggests that baseline albumin is useful for patient characterization but is insufficient, on its own, to guide universal selection of resuscitation fluids.

6. Albumin as a “Treatment”: What Do Trials, Meta-Analyses and Guidelines Show?

The SAFE trial compared iso-oncotic 4% albumin with normal saline in ICU patients and found no significant difference in overall mortality in the primary analysis [3].

The ALBIOS trial, conducted in patients with severe sepsis or septic shock, evaluated hyperoncotic 20% albumin plus crystalloids versus crystalloids alone, with a target serum albumin level ≥ 30 g/L; this strategy improved selected hemodynamic parameters and early fluid balance, without a significant reduction in day-28 or day-90 mortality in the primary analysis [4].

6.1. Safety and Traumatic Brain Injury

In a specific analysis of patients with traumatic brain injury, the use of albumin as a resuscitation fluid was associated with higher mortality [5]. As a pragmatic consequence, traumatic brain injury should be an explicit exclusion criterion in any volume optimization strategy that includes albumin.

6.2. Guidelines and Recent Syntheses

The *Surviving Sepsis Campaign* 2021 guidelines recommend crystalloids as first-line fluids and suggest albumin only after the administration of large volumes of crystalloids, consistent with a targeted rather than systematic approach [13].

Two recent syntheses focusing on hyperoncotic albumin discuss potential effects on fluid balance, shock resolution, and signals of benefit in selected subgroups, while emphasizing limitations in the overall quality of the evidence [11] [12]. Finally, a recent guideline based on a systematic review and GRADE assessment proposes a more standardized decision framework across indications and clinical contexts [14]. The main interventional trials and their key messages are summarized in **Table 2**.

Table 2. Summary of major interventional trials.

Study/source	Population	Intervention	Primary endpoint	Key result	Key cautionary point
SAFE [3]	Heterogeneous ICU population	4% albumin vs 0.9% saline	Mortality	No overall difference	Subgroup interpretation required
ALBIOS [4]	Severe sepsis/septic shock	20% albumin plus crystalloids (target ≥ 30 g/L) vs crystalloids	Day-28 mortality	No mortality benefit (day-28/day-90)	Physiological effects without consistent clinical benefit
SAFE-TBI [5]	Traumatic brain injury	Albumin vs saline	Mortality	Harmful signal	Avoid albumin in TBI critical care

7. Transposability to Cameroon: Challenges, Biases, and Blind Spots

7.1. Epidemiology, Baseline Patient Characteristics, and Structural Constraints

Published Cameroonian critical care data, although limited, describe substantial

mortality and an activity profile dominated by severe acute conditions, supporting the potential value of simple and transferable prognostic triage tools [9].

Internal medicine data from the Douala General Hospital report frequent hospital undernutrition, with lower serum albumin concentrations among undernourished patients, suggesting that a proportion of ICU admissions may present with “baseline” hypoalbuminemia related to underlying vulnerability [10]. In this context, intermittent availability of laboratory testing, pre-analytical delays, and the cost of certain products—including therapeutic albumin make a systematic correction strategy unrealistic.

7.2. Anticipated Biases in Local Studies

In local studies, several sources of bias should be anticipated. First, confounding by severity is expected, as the most critically ill patients tend to have lower serum albumin levels irrespective of any direct causal relationship. Second, dilutional bias is likely, driven by unquantified fluid resuscitation practices, transfusions, and fluid overload. Third, heterogeneity in admission and transfer delays, as well as variability in documented comorbidities, represents an additional source of variability and bias.

Accordingly, any proposed decision thresholds or albumin-based algorithms should be regarded as exploratory and require prospective local validation.

7.3. Pragmatic Proposal for Risk Stratification

7.3.1. General Principle

Serum albumin may be used as a risk modifier within a comprehensive clinical assessment rather than as a standalone score. At this stage, the proposal is deliberately qualitative, serving as an aid to clinical reasoning rather than as a quantitative adjustment of an existing score. The integrated clinical reasoning process is illustrated in **Figure 1**, and an illustrative qualitative grid is provided in **Table 3**.

Table 3. Example of a qualitative grid.

Clinical profile	Serum albumin level	Associated indicators	Interpretation (prognosis)	Suggested action (non-normative)
Shock/severe organ failure	Low	High SOFA score, elevated lactate (if available), vasopressors	High risk	Enhanced monitoring, perfusion targets, and documentation of fluid balance
Marked fluid overload	Low	Fluid resuscitation/transfusions, edema	Risk of dilutional bias	Refocus on dynamic assessment (urine output, ultrasound, balance)
Fragile baseline condition	Low/moderate	Low SOFA score, hemodynamic stability	Baseline vulnerability	Screening for undernutrition, complication prevention

7.3.2. Practical Framework for Interpreting Serum Albumin in Critical Care

First, the clinical context should be clearly defined, for example, by identifying sepsis according to the SEPSIS-3 criteria [17].

Next, situations in which serum albumin cannot be interpreted in isolation should be identified, particularly in the presence of major fluid overload, recent

transfusions, severe hepatic failure, or significant protein losses.

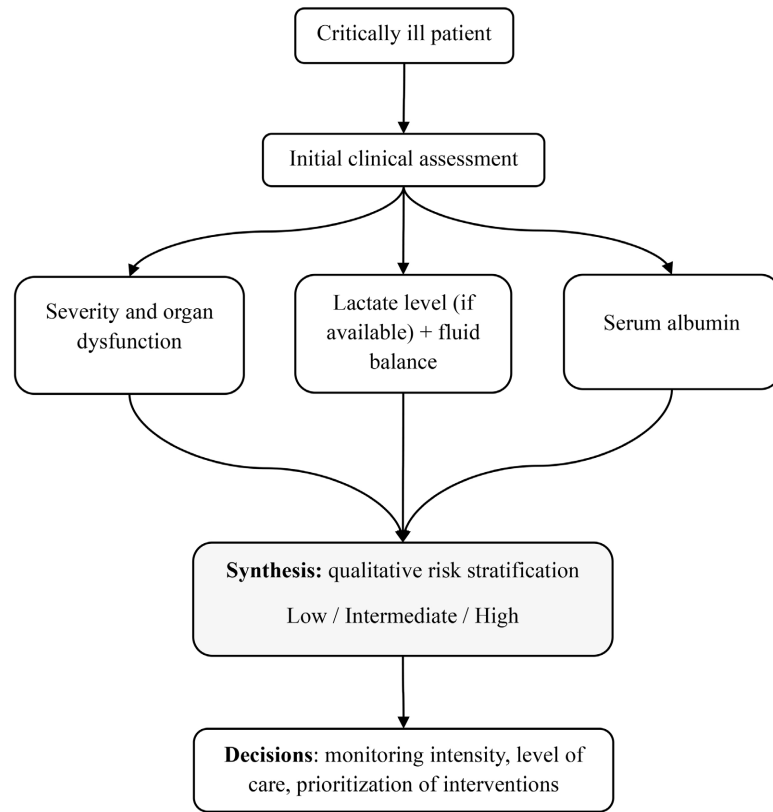


Figure 1. Conceptual framework of integrated clinical reasoning.

For therapeutic safety reasons, certain conditions must be explicitly excluded, notably traumatic brain injury, in which the use of albumin as a resuscitation fluid should be avoided [5].

Serum albumin is then integrated into a constellation of clinical and biological indicators. Low serum albumin associated with a high SOFA score, with or without elevated lactate levels when available, constitutes a signal of high overall risk. Low serum albumin in the setting of marked fluid overload instead suggests a dilutional component and requires cautious interpretation. Conversely, moderately low serum albumin combined with a low SOFA score and hemodynamic stability suggests a possibly intermediate risk related to baseline patient vulnerability, warranting recontextualization with consideration of undernutrition or comorbidities.

These different profiles are summarized in an illustrative qualitative grid presented in **Table 3**.

8. Albumin and Targeted Hemodynamic Optimization: A Physiological Hypothesis

An “albumin challenge” may be conceptualized as a short therapeutic test consisting of administering a predefined dose of albumin and assessing the clinical re-

sponse within a limited time window (e.g., mean arterial pressure, vasopressor requirements, peripheral perfusion, urine output, and echocardiographic indices when available). This concept does not aim to “correct” serum albumin levels and should never replace etiological management, including source control, antimicrobial therapy, ventilatory support, and other cornerstone interventions.

8.1. Albumin Dosing Parameters: Evidence from Trials and Cautious Transposition to the Local Context

In the ALBIOS trial, patients randomized to the albumin group received 300 mL of 20% albumin after randomization, followed by daily administration targeting a serum albumin level ≥ 30 g/L [4]. In the Cameroonian context, any transposition of this regimen should be locally protocolized, taking into account availability, cost, respiratory monitoring, and fluid balance, and should be presented as a physiological hypothesis rather than as a recommendation supported by evidence of a mortality benefit. Moreover, in routine practice observed in Cameroon, albumin administration most often corresponds to volumes ranging from 100 to 300 mL of 20% human albumin, while the cost of a single vial of this formulation represents approximately 2.6 times the average monthly income of a Cameroonian, raising a major issue of economic feasibility.

8.2. Minimum Safety Conditions

Minimum safety conditions require: 1) exclusion of patients with traumatic brain injury [5]; 2) close monitoring of respiratory tolerance and fluid balance; and 3) positioning albumin use as a targeted, non-systematic strategy, consistent with the *Surviving Sepsis Campaign 2021* recommendations, particularly after the administration of large volumes of crystalloids and on a case-by-case basis [13].

9. Practical Implications: What Can Be Recommended

1. Use serum albumin for prognostic assessment rather than as an automatic trigger for therapeutic albumin administration [1]-[4].
2. Always interpret serum albumin within its clinical context, taking into account inflammation, dilutional effects, and baseline patient characteristics [6]-[8].
3. Ensure the safe use of albumin by avoiding its administration in traumatic brain injury and by adhering to established decision frameworks from recommendations and guidelines, including algorithm-based approaches when available (**Figure 1**) [13] [5] [14].
4. Prioritize high-impact interventions such as etiological control, early antimicrobial therapy, ventilatory support, hemodynamic optimization, and prevention of complications over the isolated “correction” of a single biomarker.

10. Conclusions

Serum albumin is a robust prognostic marker in critical care; however, available

randomized controlled trials do not support a universal strategy of albumin correction. In the Cameroonian context, serum albumin may nevertheless be incorporated into a frugal risk stratification approach, provided that it is integrated into a comprehensive clinical assessment including, for example, the SOFA score, hemodynamic status, and lactate levels when available, and that its limitations related to inflammation, dilutional effects, and baseline patient characteristics are explicitly acknowledged [1] [2] [6]-[8]. From this perspective, any proposed decision thresholds or use algorithms should be presented as exploratory and require prospective local validation.

Research priorities in Cameroon may therefore include the development of prospective intensive care unit cohorts with standardized collection of severity data, fluid balance, care delays, and comorbidities; the assessment of the incremental prognostic value of serum albumin using multivariable models; and the conduct of pragmatic studies, including cost-effectiveness analyses, evaluating targeted albumin strategies while explicitly excluding patients with traumatic brain injury.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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