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Original Article

Paediatrics Section

Use of Albumin in Children with Dengue Shock: A Prospective Interventional Study from a Tertiary Care Hospital in Southern India

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ABSTRACT

Introduction: Dengue Shock Syndrome (DSS) is a major cause of paediatric morbidity and mortality in tropical regions. While isotonic crystalloids remain first-line therapy, a subset of children remains haemodynamically unstable and requires rescue fluids. Evidence supporting albumin use in paediatric DSS is limited.

Aim: To evaluate the effectiveness and safety of 5% human albumin in children with dengue shock unresponsive to crystalloid resuscitation.

Materials and Methods: This prospective interventional study was conducted in the Paediatric Intensive Care Unit (PICU) of the Department of Paediatrics, Sree Balaji Medical College Hospital, Chennai, Tamil Nadu, India, a tertiary care teaching hospital, from June 2024 and December 2024. Children aged 1-12 years with DSS who failed to stabilise after 30 mL/kg of isotonic crystalloids and subsequently received 5% albumin were included. Clinical parameters, laboratory values, fluid requirements, adverse events, and outcomes were analysed. Statistical analysis was performed using paired t-tests and descriptive statistics.

Results: Of 357 dengue admissions, 126 (35.3%) developed DSS. Fifty-eight children received albumin (mean age 7.2±3.1 years; 55% males). Mean time to shock reversal was 4.6±1.2 hours. Four children (6.9%) required a second albumin bolus. Haematocrit decreased significantly (45.3±6.2% to 39.8±5.5%; p-value=0.003) and platelet counts improved over 48 hours ($42.1\pm15.7\times10^3$/μL to $78.5\pm22.3\times10^3$/μL; p-value=0.001). Two children developed mild transient allergic reactions; no serious adverse events or mortality occurred. Mean hospital stay was 5.3±1.6 days.

Conclusion: In children with dengue shock refractory to crystalloids, albumin was effective and safe as a rescue fluid. Its use was associated with early shock reversal and favourable clinical outcomes without significant adverse effects. Larger multicentre studies are required to define its optimal role.

Keywords: Albumin, Colloid, Crystalloids, Dengue fever, Fluid therapy, Hypotension

INTRODUCTION

Dengue fever is a major mosquito-borne viral illness and an important public health problem in tropical and subtropical regions, including India. The disease spectrum ranges from self-limited febrile illness to severe dengue and DSS, characterised by plasma leakage, hypovolemia, and circulatory collapse [1,2]. Children are particularly vulnerable to rapid haemodynamic deterioration because of limited physiological reserves [3].

Dengue continues to pose a significant disease burden in India, with recurrent seasonal outbreaks reported across several states. Tamil Nadu, particularly Chennai and its surrounding districts, has consistently remained a high-risk zone due to rapid urbanisation, high population density, water stagnation, and favourable climatic conditions for Aedes aegypti breeding. Chennai has frequently reported a substantial proportion of dengue cases in the state, with periodic surges during the monsoon and post-monsoon months leading to increased paediatric admissions. Tertiary care hospitals in this region often cater to large catchment populations from both urban and peri-urban areas, resulting in a high caseload of dengue-related complications including DSS. This ongoing regional burden highlights the importance of evaluating optimal fluid resuscitation strategies, especially in children, to reduce morbidity and mortality associated with severe dengue. As per the information from Directorate of public health, Tamil Nadu, India. Dengue cases have shown an increasing trend in Chennai in the recent years, with 522 cases recorded from January to early July 2025, compared to 381 in the same period in 2024, indicating a rising local incidence in the pre-monsoon and early monsoon period. As of October 2025, Chennai had reported at least 600 dengue cases in that month alone, contributing to a yearly total of around 1,633 cases, though state data suggested even higher numbers (up to ~4,700 cases) for the city in 2025-reflecting possible underreporting or differences in surveillance. In the broader state of Tamil Nadu, dengue burden has been substantial: the state recorded around 26,740 dengue cases with 13 fatalities in 2024 and continued high case numbers into 2025. Between January and November 2025, Tamil Nadu reported approximately 20,866 dengue cases with 12 deaths, placing it among the highest dengue-burdened states in India during that period [4,5]. These figures underscore that dengue is not only a national and regional public health concern but a significant and evolving local health challenge in Chennai and the hospital's catchment area, especially during peak transmission seasons (monsoon and post-monsoon).

Fluid resuscitation remains the cornerstone of DSS management. The World Health Organisation (WHO) and national guidelines recommend isotonic crystalloids as first-line therapy, with colloids reserved for patients who do not respond adequately to crystalloids [6-8]. Although crystalloids are widely available, large volumes may be required in severe shock, increasing the risk of fluid overload. Albumin, a natural colloid, offers theoretical advantages by restoring oncotic pressure and intravascular volume more rapidly [9].

Evidence supporting colloid or albumin use in paediatric dengue shock is limited, with most available studies [10-14] being small, heterogeneous, or conducted predominantly in adult populations.

Moreover, the role of colloids in DSS remains controversial. Although albumin offers advantages by restoring oncotic pressure and expanding intravascular volume more rapidly, clinical studies [11-14] have shown inconsistent findings. Some reports [11,12] suggest that colloids, especially Albumin, may achieve faster haemodynamic stabilisation and reduce the need for repeated fluid boluses, particularly in children with profound shock. In contrast, other studies [13,14] have demonstrated no significant improvement in clinically meaningful outcomes such as mortality, duration of shock, or length of hospital stay. Concerns regarding adverse effects, including fluid overload, pulmonary oedema, and the high cost of albumin further contribute to uncertainty. Consequently, while current WHO and national guidelines [6-8] recommend crystalloids as first-line therapy and reserve colloids for refractory shock, the optimal fluid strategy for paediatric DSS remains an area of ongoing debate. Given this evidence gap and ongoing debate, this study was undertaken to evaluate the effectiveness and safety of albumin in children with DSS in a tertiary care setting in Southern India. The objective was to assess clinical outcomes, safety, and fluid requirements in children with DSS, receiving albumin as rescue therapy as a part of resuscitation

MATERIALS AND METHODS

This prospective interventional study was conducted in the PICU of Sree Balaji Medical College and Hospital, Chennai, Tamil Nadu, India, a tertiary care teaching hospital, from June 2024 and December 2024. Institutional Ethics Committee approval was obtained (IEC No. SBMC/2024/1359), and written informed consent was obtained from parents or legal guardians.

Inclusion criteria: Children aged 1-12 years with laboratory-confirmed dengue infection (NS1 antigen and/or dengue IgM ELISA positive) who developed DSS (severe plasma leakage leading to shock) as per the WHO revised dengue classification [6,7], and remained haemodynamically unstable after receiving 30 mL/kg of isotonic crystalloids, were included.

Exclusion criteria: Children with pre-existing cardiac, renal, or chronic liver disease and known hypersensitivity to albumin were excluded from the study.

Sample size: All eligible children meeting the inclusion criteria during the study duration were enrolled. A total of 58 children with DSS received albumin.

Study Procedure

All children with DSS initially received isotonic crystalloid resuscitation as per WHO and national protocols [4-6]. Those who failed to achieve haemodynamic stability after 30 mL/kg crystalloids, received 5% human albumin as colloid at a dose of 10-20 mL/kg infused over 30-60 minutes, a dosage range consistent with CDC dengue management guidelines [15], National guidelines on dengue fever case management by Ministry of Health and Family Welfare, Government of India [8] and Standard Operating Protocol for Dengue management in Tropics, Pannu AK et al., that recommend colloid administration of 10-20 mL/kg (standard dose as per department protocol) when shock persists despite crystalloid therapy and clinical reassessment [16]. According to CDC dengue case management guidelines [15], albumin is used as resuscitative fluid therapy for crystalloid refractory dengue shock, specifically when patients do not respond to 2-3 boluses of isotonic crystalloid solutions. Albumin dose selection was individualised based on body weight, severity of shock, haematocrit levels, and response to initial fluids, in line with published paediatric dengue studies.

A second albumin bolus of 10 mL/kg was administered if shock persisted, and there were no clinical signs of fluid overload in the form of basal crepitations, hepatomegaly or worsening respiratory distress, in accordance with CDC dengue management guidelines [15].

Monitoring and outcomes:

Continuous monitoring of heart rate, blood pressure, pulse pressure, capillary refill time, urine output, and respiratory status was performed. Laboratory parameters including haematocrit, platelet count, and serum Sodium were measured serially and analysed. The primary outcome was time to shock reversal. Secondary outcomes included total fluid requirement, laboratory recovery, adverse events, need for repeat albumin infusion, and length of hospital stay [11,12].

STATISTICAL ANALYSIS

Data were analysed using Statistical Package for Social Sciences (SPSS) version 26.0. Continuous variables were expressed as mean±standard deviation. Categorical variables were expressed as percentages. Paired t-tests were used to compare pre- and post-resuscitation laboratory values. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 58 children with DSS received albumin. The mean age was 7.2±3.1 years and 32 (55.17%) children were male. All 58 (100%) children presented with clinical features of poor perfusion including cold extremities, prolonged capillary refill time (4.1±0.8 seconds), and narrow pulse pressure. Oliguria was present in 41 (70.68%) patients. Baseline demographic, clinical, and laboratory characteristics are summarised in [Table/Fig-1].

Variables	Value
Age (years), (Mean±SD)	7.2±3.1
Male , n (%)	32 (55.17%)
Weight (kg), (Mean±SD)	22.5±8.4
Duration of fever (days), median (IQR)	5 (4–6)
Cold extremities, n (%)	58 (100%)
Capillary refill time (seconds), (Mean±SD)	4.1±0.8
Narrow pulse pressure (<20 mmHg), n (%)	58 (100%)
Oliguria at presentation, n (%)	41 (70.68%)
Haematocrit (%), (Mean±SD)	45.3±6.2
Platelet count (×10^3/µL), (Mean±SD)	42.1±15.7
Serum sodium (mmol/L), (Mean±SD)	136±4.2

[Table/Fig-1]: Baseline demographic, clinical, and laboratory characteristics (N=58).

The mean time to shock reversal after albumin administration was 4.6±1.2 hours. Only 4 children (6.89%) required a second albumin bolus due to persistent shock. The mean total fluid requirement, including crystalloids and albumin, was 52.3±10.4 mL/kg. No child developed clinical evidence of fluid overload or pulmonary oedema.

Laboratory parameters showed significant improvement following resuscitation [Table/Fig-2]. Serum sodium levels showed no statistically significant change post-resuscitation. Serum potassium and chloride levels also remained stable following albumin administration, and no clinically significant electrolyte disturbances were observed.

Parameters	Pre-resuscitation (mean±SD)	Post-resuscitation (mean±SD)	p-value
Haematocrit (%)	45.3±6.2	39.8±5.5	0.003
Platelet count (×10^3/µL)	42.1±15.7	78.5±22.3	0.001
Serum sodium (mmol/L)	136±4.2	137±3.8	0.07

[Table/Fig-2]: Laboratory parameters before and after albumin resuscitation. Paired Student's t-test. A p-value <0.05 was considered statistically significant.

Two children (3.4%) developed mild transient allergic reactions to albumin, which resolved with conservative management. No serious adverse events, need for mechanical ventilation for respiratory

distress due to fluid overload, or mortality were observed. This suggests that albumin is generally safe for plasma expansion in children with DSS. The therapeutic benefits of restoring blood volume without massive third-space fluid accumulation outweigh the minimal allergic risk. The mean duration of hospital stay was 5.3±1.6 days.

DISCUSSION

The present study demonstrated that albumin is an effective rescue fluid in children with dengue shock unresponsive to crystalloid therapy. The total fluid requirement including albumin 52.3±10.4 mL/kg and the mean shock reversal time of 4.6±1.2 hours are comparable to studies by Kaur A et al., and Myathari R and Gupta AM reporting faster haemodynamic stabilisation with colloids [12,17]. A comparative study by Ngo NT et al., reported significantly higher survival (97.1% vs. 77.1%), reduced vasoactive support, and fewer complications among children receiving albumin for fluid-refractory shock in severe dengue [18]. Similar benefits have been observed in multicentre paediatric studies by Ngo NT et al., Mohan M and Batra P and Trieu HT et al., where albumin use was associated with improved outcomes decreased need for inotropic support, and reduced morbidity without increased adverse events in children with severe dengue shock [18-20]. As a colloid, 5% albumin increases the plasma oncotic pressure, which helps to maintain intravascular volume and pull fluid that has leaked into the "third space" (tissue spaces) back into the bloodstream. Albumin helps repair and maintain the glycocalyx (the protective inner layer of blood vessels) and reduces the gap between endothelial cells, thus sealing the leaks [19]. These observations suggest that albumin may limit excessive crystalloid administration, an important consideration as fluid overload has been linked to respiratory failure and acute kidney injury in DSS [21].

Only a small proportion of children required repeat dosing, consistent with prior paediatric trials emphasising titrated rather than liberal colloid use [11,12]. The favourable safety profile observed aligns with previous studies reporting low rates of albumin-related adverse effects when used judiciously [12,17,19]. Improvement in haematocrit and platelet counts observed reflects stabilisation of intravascular volume and reduced haemoconcentration, key therapeutic targets in DSS. The findings align with comparable studies by Myathari R and Gupta AM ,Yacoub S et al., Bur R et al., suggesting that albumin may contribute to preservation of endothelial integrity and mitigate plasma leakage [17,22,23]. The mean duration of hospital stay was 5.3±1.6 days which was similar to the mean 6.0 days (4.41-7.60 days), observed by Ranji S et al., in the albumin group [11]. Overall, the present study supports the role of albumin as a safe and effective rescue fluid in children with DSS who remain unstable after initial crystalloid resuscitation. The observed rapid shock reversal, low requirement for repeat boluses, stable biochemical parameters, and absence of major complications suggest that albumin may be a valuable option in carefully selected cases.

Limitation(s)

Limitations include the single-centre design, small sample size, and lack of a comparator group. Despite these limitations, the study adds valuable paediatric-specific data from a resource-limited setting. Future studies should focus on multicenter randomised trials comparing albumin to other colloids and crystalloids, evaluating both short- and long-term outcomes, cost-effectiveness, and optimal dosing strategies.

CONCLUSION(S)

Albumin appears to be safe and may be effective as a rescue fluid in children with dengue shock refractory to crystalloid therapy. Its use was associated with early shock reversal, improvement in haematological parameters, and absence of serious adverse events. Albumin may be considered in carefully selected paediatric DSS cases within monitored PICU settings, while larger multicentre trials are needed to guide definitive practice.

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