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Role of Albumin Infusion in Treatment outcome and Preventing DSS in Children with DF: A quasi Experimental Study

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Abstract:

Background: Growing number of Dengue patients posed a threat to the community. It also stood with a great deal of challenge to the physicians working in the hospitals and treating the pediatric patients yet looking for a straightforward approach to deal with severe cases of Dengue. Observing the low albumin status in every single Dengue Shock Syndrome (DSS) the concept of arresting the progression of DF (Dengue Fever) to DSS (Dengue Shock Syndrome) came in our mind. Therefore, the study topic was selected as "Role of albumin infusion in treatment outcome and preventing DSS in children with DF: A quasi purposive study."

Objective: The objectives of the study were to observe the status of albumin of DF, the relationship of Albumin with Platelets, the effect of albumin infusion on the progress of DF to DSS.

Patients and Methods: This is a prospective quasi purposive study conducted in the department of Pediatrics at Bangladesh Specialized Hospital (BSH) from June 2022 to December 2022 in the age group of Pediatric patients (from more than 1 month eighteen years). All the patients admitted with DF or DSS during that period were included in the study. National Guideline of DF and DSS was followed to Diagnose and to hydrate the Dengue affected children. Albumin was administered to manage not only DSS but also DF children to prevent them from progressing to DSS. They were managed following the national guideline. Additionally, Hct and Albumin status were closely monitored particularly on day five, six and seven of the disease. Albumin was administered according to the set protocol for this study.

Results: A total of 44 cases were included in the study. Among them 28 DF and 16 DSS were diagnosed and documented in this study. Twenty-seven male and seventeen female children were admitted with common symptoms like Fever, bodyache, headache, abdominal pain, vomiting and loose motion. A total of thirty-six children were administered Albumin. Among them 21 were DF and 15 were DSS. In statistical analysis no significant difference was found in Age, Weight, Hematocrit (Hct), Ferritin on admission when compared between DF and DSS. No significant difference could be observed also in Hospital Stay as compared between the two groups. However, significant statistical differences were detected in Day 1, 2, 3 platelet levels and Day 1 and 2 Albumin levels. Neither any DIC nor any MISC, nor any death was recorded. No antibiotic was required. No Platelet transfusion, no IVIG, no Methylprednisolone, nor any other steroid was needed. No significant adverse effect was documented in administering Albumin.

Conclusion: In this study it has been found that albumin is safe to use in children with DF to prevent DSS. It also is effective in reducing morbidity in Dengue affected children.

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Introduction:

Dengue was first recorded in the 1960s in Bangladesh (then known as East Pakistan) and was known as "Dacca fever". Since 2010 cases of dengue appear to coincide with the rainy season from May to September and higher temperatures. Bangladesh's climate conditions are becoming more favorable for the transmission of dengue and other vector-borne diseases including malaria and chikungunya virus due to excessive rainfall, waterlogging, flooding, rise in temperature and the unusual shifts in the country's traditional seasons.[1]

Because course of Dengue fever being very unpredictable sometimes posing threat and challenges very difficult to overcome mere following national

guideline to treat the critically ill dengue patients was proving futile. Often it was observed that despite very well hydration and meticulous management according to National guideline for Dengue patients[2] a number of children were developing Dengue Shock Syndrome (DSS) inviting clinical disasters. However, it was also seen that DSS was associated with generalized edema, ascites, pleural effusion and was associated with hypoalbuminemia[2]. Here in this point our focus of management was drawn. And we then started to focus all our effort to keep albumin within normal range. That detecting the falling level of albumin and replacing albumin earlier eased our Dengue patient management much more as we were able to reverse the trend to fall of albumin reducing morbidity and even preventing shock. As this was our observation we felt the necessity to convey this message to the community through a well-designed scientific study with series of Dengue patients. In this context the research was carried out to observe the status of albumin of Dengue Fever (DF), the relationship of Albumin with Platelets, the effect of albumin infusion on the progression of DF or DSS and the progress of the patients while treated with infusion of Albumin.

Materials and Methods:

This was a prospective quasi-purposive study carried out in the department of Pediatrics of Bangladesh Specialized Hospital (BSH), from June 2022 to December 2022. The patients aged from more than 2 months to 18 years, irrespective of their gender and morbidity, if admitted with the diagnosis of DF or DSS were included in the study. The patients diagnosed after admission as DF or DSS were also accepted for the study. The purpose of the study and the proceedings of the study were explained to the parents. They were included in the study with their verbal consent. Those who did not want to get into the study were ruled out from it. Ethical clearance was obtained from the Ethical Committee of the hospital. There was no conflict of interest to conduct the study. The diagnosis of Dengue fever and DSS were done on the basis of clinical suspicion according to National Guideline and after serological confirmation.[3] It was a prospective study with a questionnaire that was tested in small scale before being implemented.

In the treatment of Dengue initial aim was to restore the intravascular volume and to keep the pulse and BP normal. Hct and Albumin were checked twice a day. Platelet was viewed as the factor to show the activity of disease only. . In case of fall of albumin the protocol of Albumin infusion that followed was o.5 g/kg of infusion (Over 4 hrs) if the level showed >38 to 35 g/L and to check it 12 hourly or according to presence of risk factors, if 35 to 30 g/L then 0.5g/kg 12 hourly (checking albumin level every time before Albumin infusion), if 20 to 25g/L 1g/Kg 8 hourly, below 20g/L 1g/kg of infusion 6 hourly. In case of Hemoconcentration evidences of fluid leak was important which used to be consistently found in hypoalbuminemia particularly when albumin level was around 30g/L or below. It is a point to be noted that clinical care to note the fluid balance on eight hourly basis, the pulse and BP, careful precordial examination were extremely important to note the volume overload. In case of hemodilution the consideration of Furosemide was given the special priority alongside the clinical evidences of fluid overload. In this respect, the pulse, Output-intake balance, BP, loudness of heart sound was given the special emphasis. It would be noteworthy that in case of patients that came with gross evidences of fluid leak the infusion of fluid was kept sub-per anticipating the reversal of fluid from extravascular to intravascular space and causing overload. The protocol of treatment did not consider any level of platelet for transfusion of platelet, no antibiotic was administered, no steroid or IVIG was given unless the symptoms were consistent with the laboratory results of DIC or MISC or infection. The supportive measures were taken as required.

The patients were discharged as they showed subjective improvement with the improvement in their laboratory results as followings on day seven or day eight of Dengue Fever without any evidence of complications. The lab results that guided us to discharge were – beginning to increase in platelet count spontaneously without transfusion and improvement of status of albumin to 35 g/L or more spontaneously and not aided by infusion of albumin.

The data gathered through the questionnaire were compiled and entered into SPSS version 29 and was analyzed. The level of significance considered was P<0.05. To compare the Means between the groups of DF and DSS Independent T test was done. To compare the groups non-parametric test was done as Chi-square test that was shown in Table 5.

Results:

In total of 44 cases 27 were male and 17 female distributed here demonstrating the trend of weight as age increased (Figure 1). Figure 2 showed the comparative bar diagram showing 28 children in DF and 16 in DSS groups. Table 1 showed the number of DF and DSS and their distributions in respect with Min, Max and mean Age, Weight, Hct, Ferritin ng/ml and Hospital stays comparing them between the groups finding no significant statistical differences. Figure 2 showed the comparative bar diagram showing 28 children in DF and 16 in DSS groups. Figure 3 presented here the symptoms the Dengue children admitted with. All had fever and with fever they had the common symptoms like abdominal pain (34%), bodyache (12%), loose motion and vomiting (10%) and some varieties of mixture of symptoms. Figure 4, 5, 6 and 7 are the scatter dot charts presented here the DF and DSS cases with their Hct and Albumin levels during their Day 1, 2, 3 and 4 of Hospital stays respectively. The dots also are marked differently to get the view of the timing of Infusion of Albumin in every single case. These figures got us a view of Hct fall and rise with the level of Albumin.

In Table 2, from statistical analysis it became clear that no significant difference was noted in hemo-concentration on admission and on day 2 between the groups. However, statistically significant (P=0.02) lower concentration in Day 3 could be noticed in DSS group after intervention with Albumin for the first 2 days. Again hemoconcentration in the subsequent two days (Day 4 and Day 5) did not show any statistically significant difference between the groups. Complemented with it Table 3 clearly depicted here the significant statistical differences of mean and SEM between two groups. DSS group was found to have significantly low platelet mean in day 1(P<0.001), Day 2 (P<0.001) and in day 3 (P=0.008) marking the more intensity of disease

Fig.-1: *Distribution of cases according to Age, Gender and Weight:*

activities in DSS group. Keeping Table 4 at its side it could be well visualized that in first two days of follow up there were significant statistical differences between the groups, DSS obviously having the lower means having P values <0.001 and 0.04 respectively. The subsequent days of 3, 4, 5 and 6 did not show any significant statistical difference.

In the context of all these presentations and analysis Table 5 here did highlight the most important aspect to pick from this study comparing Levels of albumin that was divided in Normal level all through, Normal Albumin on admission and 35 to 40g/L later, and Albumin level 30 to 35g/l on admission and Albumin below 30 g/l on admission, pointing to the statistically significant difference between the groups (P<0.001). It is known that DSS would have significantly lower concentration of albumin but here in this table most important should be the cluster of twenty in DF group with Normal albumin on admission and 35 to 40g/l later.

Table 6 depicted here the comparison of the numbers of DF and DSS and their timing of requirement of Albumin infusion in the study. In DF seven patients did not require Albumin at all. Even a DSS case did not require infusion of Albumin. Eighteen DF required Albumin after twelve

Table-I

Comparative analysis of the differences between the DF and DSS with respect to Age, weight, levels of Ferritin and Hosp Stay

Variables	Diagnos	No	Min	Max	Mean	SEM	df	T	p
Age(Mo)	DF	28	5	178	106.64	8.68	42	-.47	0.63
	DSS	16	8	194	114.37	15.03			
Wt (Kg)	DF	28	5.3	93	37.95	4.09	42	0.58	0.56
	DSS	16	7	88.6	42.11	6.25			
Hct % (time?)	DF	28	22.5	45.1	36.58	0.78	42	-1.14	<0.259
	DSS	16	22.8	54.5	39.09	2.38			
Ferritin(ng/ml)	DF	28	84.8	37058	4972.44	2170.57	33	-0.65	0.51
	DSS	16	80.92	60000	7999.49	4826.48			
Hosp stay (days)	DF	28	1	6	3.39	0.28	42	-1.6	0.113
	DSS	16	2	9	4.25	0.48			

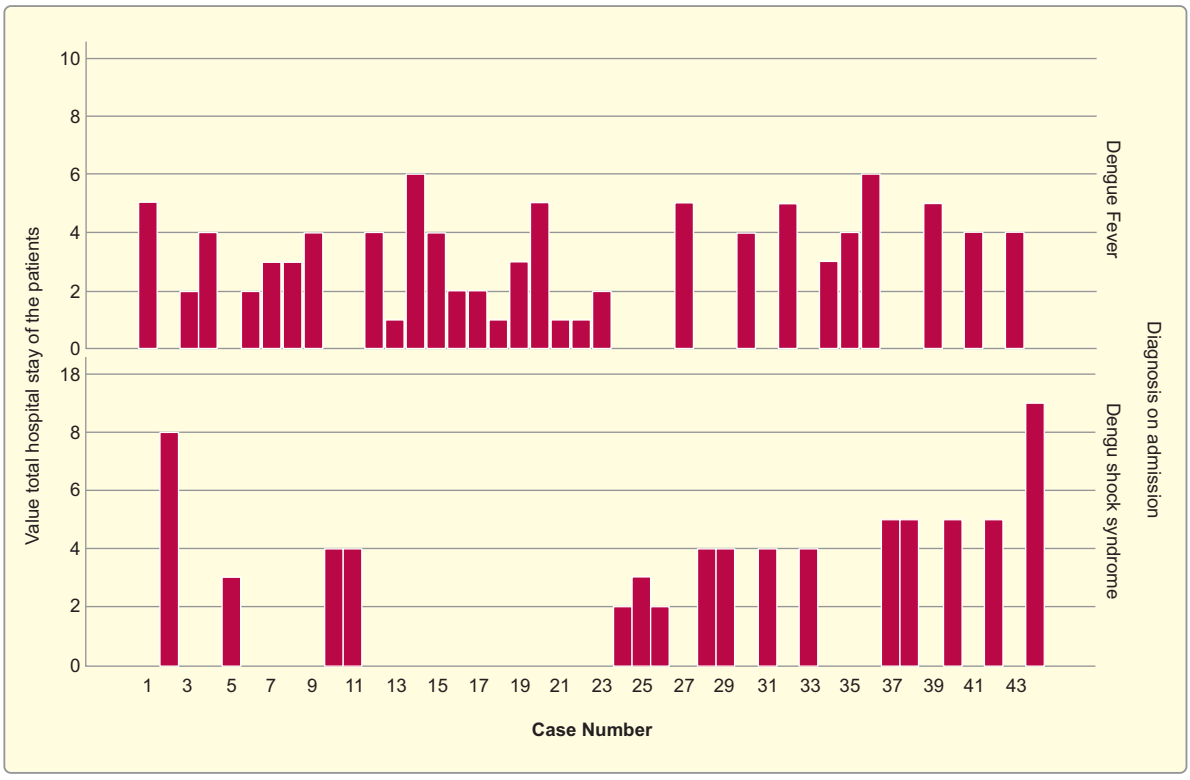

Fig.-2: *Hospital stays of DF and DSS patients included in this study*

hours of admission where as thirteen DSS patients out of sixteen required Albumin infusion immediately after admission. The Statistical analysis vivified the significant difference between the two groups.

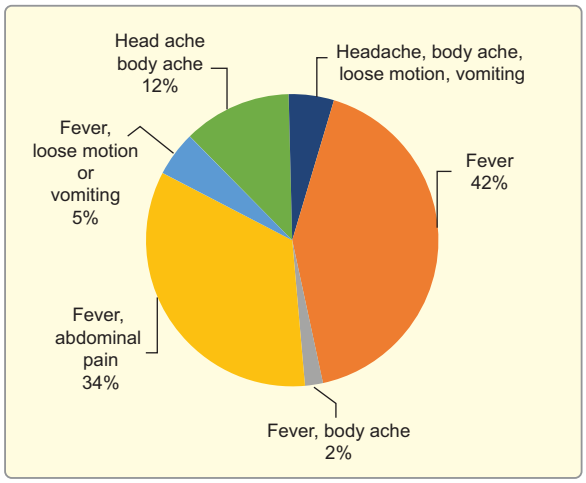

Fig.-3: *Distribution of cases according to symptoms they presented with*

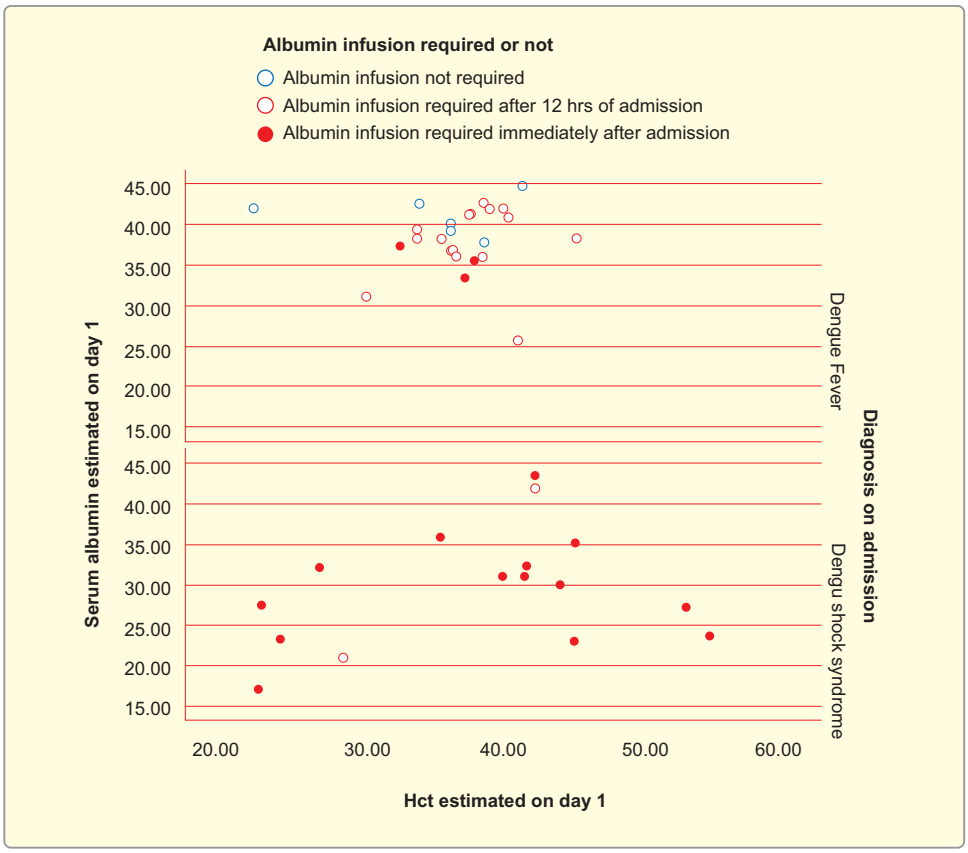

Fig.-4: *DF and DSS with Hct and Albumin levels in Day 1 of Hospital Stay showing the time of administration of albumin.*

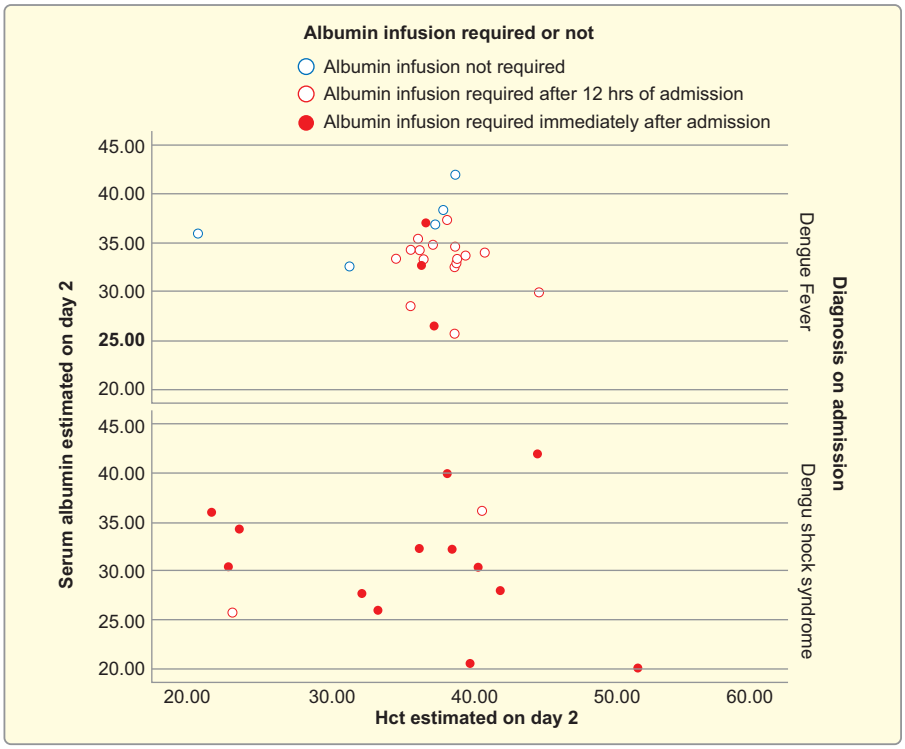

Fig.-5: *DF and DSS with Hct and Albumin levels in Day 2 of Hospital Stay showing the time of administration of albumin.*

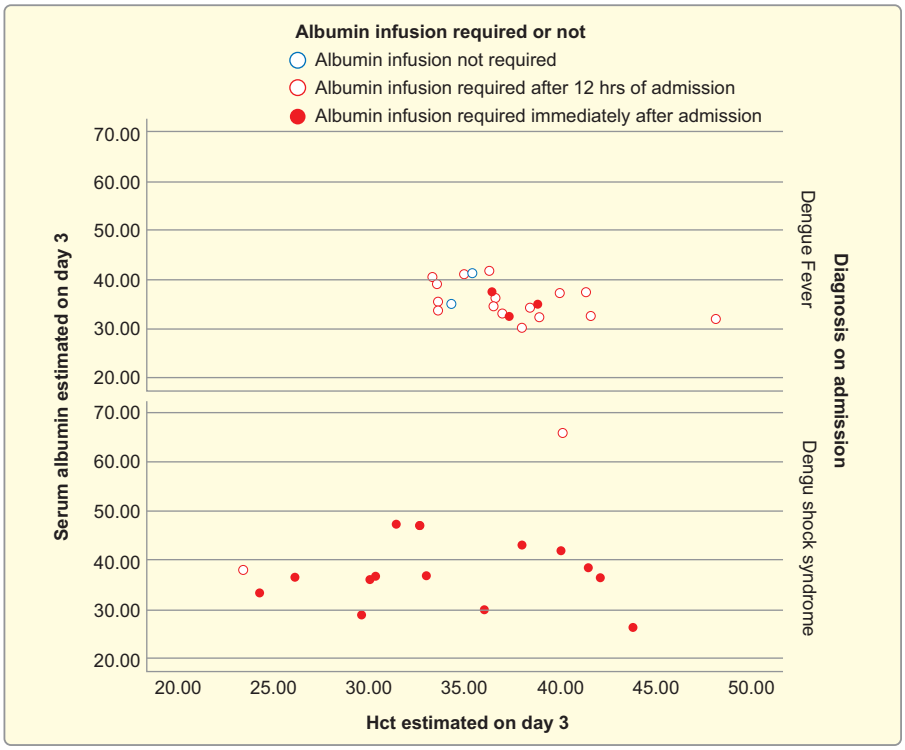

Fig.-6: *DF and DSS with Hct and Albumin levels in Day 3 of Hospital Stay showing the time of administration of albumin.*

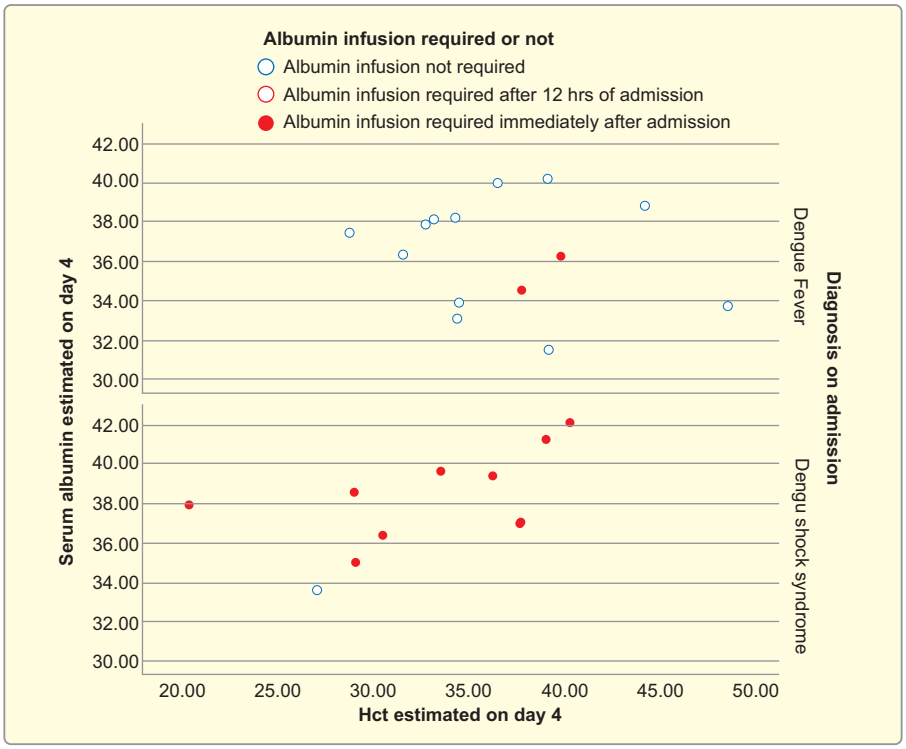

Fig.-7: *DF and DSS with Hct and Albumin levels in Day 4 of Hospital Stay showing the time of administration of albumin.*

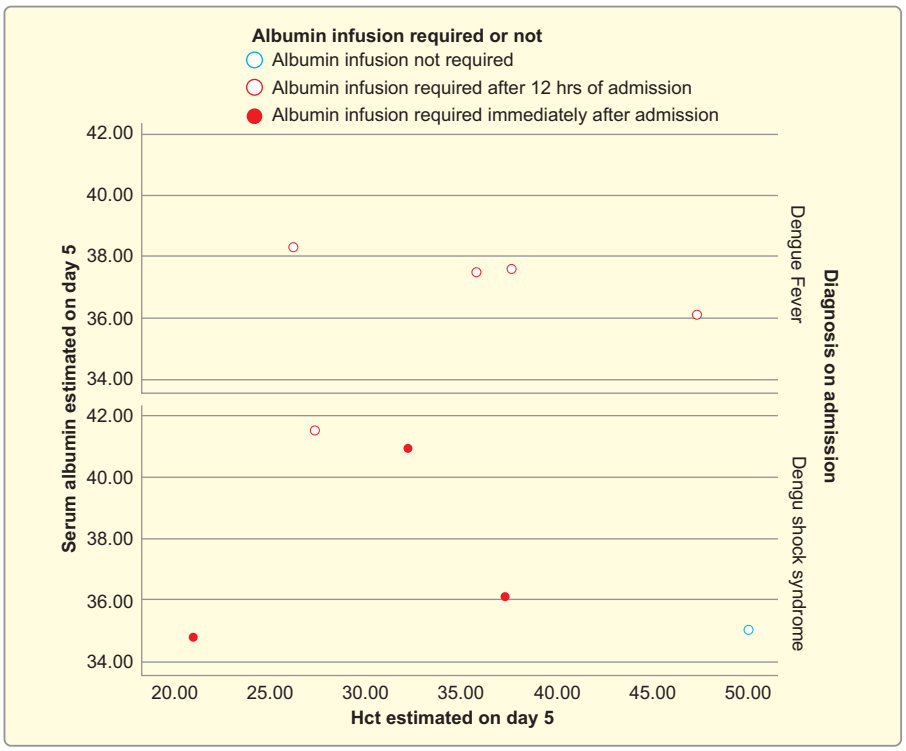

Fig.-8: *DF and DSS with Hct and Albumin levels in Day 5 of Hospital Stay showing the time of administration of albumin.*

Table-II

Comparative analysis of the differences between the DF and DSS with respect to level of Hct%

Days	Diag	No	Min	Max	Mean	SEM	df	t	P
Adm	DF	28	22.5	45.1	36.58	0.78	42	-1.2	0.23
	DSS	16	22.8	54.5	39.09	2.38			
Day 2	DF	26	21	44.7	36.9	0.79	40	0.869	0.39
	DSS	16	21.9	51.6	35.2	2.16			
Day 3	DF	23	33.3	48.1	37.4	0.70	37	2.31	0.02
	DSS	16	23.4	43.7	33.6	1.64			
Day 4	DF	15	29.1	48.8	37.3	1.33	27	1.83	0.07
	DSS	14	20.8	40.6	33.6	1.59			
Day 5	DF	9	26.3	47.3	36.5	1.79	14	0.78	0.44
	DSS	7	21.1	50	33.6	3.49			
Day 6	DF								
	DSS	1	29.1	29.1					

Table-III

Comparative analysis of the differences between the DF and DSS with respect to level of Platelet ($x10^9/L$)

Days	Diag	No	Min	Max	Mean	SEM	Df	t	p
Adm	DF	28	50	343	135.64	14.04	42	4.7	<0.001
	DSS	16	7	136	43.1	8.32			
Day 2	DF	26	17	202	88.7	9.99	39	4.1	<0.001
	DSS	15	10	76	53.66	7.57			
Day 3	DF	22	11	190	76.7	10.24	35	2.8	0.008
	DSS	15	10	76	32	4.41			
Day 4	DF	15	10	100	53.6	7.57	25	-0.92	0.364
	DSS	15	1	88	38.6	6.57			
Day 5	DF	8	15	114	62.3	12.23	13	0.31	0.760
	DSS	12	22	240	70.4	17.98			
Day 6	DF	1	67	67					
	DSS	7	15.5	120	56.6	13.85			

Table-IV

Comparative analysis of the differences between the DF and DSS with respect to level of Albumin g/l:

Days	Diag	No	Min	Max	Mean	SEM	df	T	p
Day 1	DF	26	25.8	44.7	38.3	0.79	40	4.70	<0.001
	DSS	16	17.3	43.5	30.3	1.76			
Day 2	DF	25	25.7	42	33.7	0.7	39	2.06	0.04
	DSS	16	20.1	42	30.6	1.54			
Day 3	DF	21	30.1	41.6	35.8	0.74	35	-.87	0.386
	DSS	16	26.2	66	37.7	2.34			
Day 4	DF	14	31.5	40.2	36.4	0.72	22	-1.4	0.148
	DSS	10	33.6	42.1	38.0	0.84			
Day 5	DF	8	36.1	40.2	38.4	0.49	12	1.14	0.273
	DSS	6	33.2	41.5	36.9	1.4			
Day 6	DF	2	35.2	37.6	36.4	1.2	2	-1.08	0.392
	DSS	2	37.7	37.7	37.7	0			
Day7	DF								
	DSS	1	110	110					

Table-V

The comparative analysis of the status of Albumin between the groups of DF and DSS

		Diagnosis on admission		Total
		Dengue Fever	Dengue Shock Syndrome	
Level of albumin in serum of dengue patients	Normal albumin level all through	7	1	8
	Normal albumin on admission and 30 to 40g/L later	20	6	26
	Albumin level 30 to 35g/L on admission	0	2	2
	Albumin level below 30g/l on admission	1	7	8
Total		28	16	44

X^2 16.49, df 3, P <0.01

Table-VI

Comparison of the timing of Albumin infusion between DF and DSS at diagnosis

		Diagnosis on admission		Total
		Dengue Fever	Dengue Shock Syndrome	
Albumin infusion required or not	Albumin infusion not required	7	1	8
	Albumin infusion required after 12 hrs of admission	18	2	20
	Albumin infusion required immediately after admission	3	13	16
Total		28	16	44

X^2 21.97, df 2, P<0.001

Discussion:

This study was conducted to observe the status of albumin, the status of platelets, their relationship, the effects of albumin infusion on the treatment outcome as well as the progress of the patients on the basis of the outcome. The very characters of the patients here showed that the age range covered from five months to sixteen years with the weight varying accordingly. The table also showed a variable hemoconcentration throwing a variable amount of challenges during patient management as expected[4]. The most important and interesting part was in hospital stay having no difference between the two groups of DF (Dengue Fever) and DSS (Dengue Shock Syndrome). This is also noteworthy that the patient came with Dengue Shock syndrome but stayed only 2 days in the hospital, improved and was discharged uneventfully. It could be noted that among sixteen DSS patients only one patient stayed for 9 days and the other for eight days in the hospital. These two are the patients that were managed in other centers first, complicated and then were transferred to our PICU. None else in the group of DSS stayed for more than five days. It must also draw one's attention that no significant difference was found in the Hospital stay between DF and DSS. The mean hospital stay here was also similar to the other internationally reputed hospitals abroad that dealt with dengue patients in this part of the globe.[5,6] With the kind of treatment by infusion to keep vitals normal, to keep Hct normal and to address the low albumin status by infusion of albumin required to keep the hemoconcentration at its normal range the infants even below six months in this study could be easily managed with incredible success and amazing convenience.

The fall of platelet evident in every single individual. Some of the patients had severe fall with severely low Platelet that improved as the day of affection with Dengue approached on day 8 (Of Disease not hospital stay) and occasionally at day 7 (Of disease not the hospital stay). However not a single patient did require transfusion of Platelet. It must be reiterated here even the one who had platelet count fallen to $1x10^9$/L did not require platelet and showed rise of it spontaneously. This also is very consistent with the recommendations following scientific trials in the treatment of Dengue Fever.[7]

Infusion of Albumin is the key factor in this study. The initial fall within couple of days after admission and then rising within a normal range was noted. The Albumin level maintained the steady state until discharge. The rise of Albumin and maintaining the steady state all through were the result of infusion of albumin as mentioned in the protocol. Similar intervention was found in a research article published on the basis of a scientific work conducted in Pediatric ICU in Apollo Hospital Chennai.[8] However, difference between their work and ours was while intervention was done with infusion of Albumin in only severe cases that were admitted to PICU in their study then in the current study we administered albumin not only in severe cases but also in Dengue Fever that was threatening to evolve to a severe one as Albumin just started to show decline. That was why we did not have any patient developed shock or DHF after the admission to our care. In our study shock status did not last for more than first 24 hrs of hospital admission.

In this study Hct was higher initially. With hydration and with the carefully executed protocol of Albumin infusion Hct was kept within normal range which was the key factor of such an easy looking success that was achieved in this study. It would be pertinent to mention that DSS cases had higher minimum, maximum and mean levels of Hct as compared to that of DF cases in day 1 and day 2 of hospital stay. Here, with the treatment and protocol of hydration and albumin infusion the hemoconcentration in day 3 and day 4 of hospital stay were lower than the DF patients. It occurred because almost all the DSS patients had certain outflux of plasma from vascular space to the extravascular space. In first two days the Infusion of crystalloids and Infusion of Albumin reinstated the blood level of Hb as well as Albumin causing the fluid back again to vascular space from its extravascular location. This did result in lower min, max and mean levels of Hct in DSS than that of DF. This is also pretty similar to the other studies conducted before.[9] The measures to keep the status of hydration to a normal level was certainly behind the cause of not having any DHF in this study. [10]

Hemoconcentration could very successfully be controlled in this study. Next to hemoconcentration the essential factor in case of Dengue is progressive Thrombocytopenia that was found significantly lower in DSS in the first three days of hospital stay. Although

there was no significant difference between the hospital stay of DF and DSS patients suggesting that the day of presentation or admission was pretty similar regardless of the shock status. However, highly significant statistical differences between the groups suggested that DSS group was marked by the sharper fall of platelets in this study. Then, with the treatment the disease progression got under control and improvement of platelet began with the disease approaching day 7 or day 8. It is to be noted that in Day 4 minimum platelet count showed was $1x10^9$/L and then it started to improve spontaneously not requiring any transfusion of Platelet. Not a single transfusion of Platelet was required in our study. This was not similar to the other studies reported. Although they appreciated that platelet transfusion could not minimize the risk of bleeding in severe Dengue yet they transfused platelet when count fell below the critical level and in cases of DHF.[11] In fact, not a single patient developed DHF in this study.

Similar to count of Platelet the albumin also showed significantly low status in first two days of hospital stay. Again, with the infusion protocol of Albumin the status could be brought back to normal and under control that was reflected showing no differences between the groups of DF and DSS in subsequent days of treatment. This was the most important underlying point highlighted in the study. This indeed was the most crucial factor in this study. It must be appreciated here that infusion of Albumin always incurred certain amount of risks including kind of Anaphylaxis. The injudicious and rapid infusion could result in volume overload and pulmonary edema resulting in detrimental consequences.[12] Additionally with the albumin status brought back to normal the continuing infusion as well as influx of fluid from extravascular to intravascular space could easily cause pulmonary edema, heart failure, ARDS and respiratory failure. To guard against that complication meticulous check of vitals of the patients, careful assessment of Intake and output fluid balance chart and carefully executed plan of monitoring Hct and Albumin status certainly would avoid volume overload and its consequences that easily could overturn the benefit of Infusion of Albumin. Again, because not a single casualty did occur in our study obviously underlined the importance of precise and focused follow ups to stick to the protocols of administration of Albumin. This would not be irrelevant to say that although the study consisted of 44 cases only yet with the same principles the 250 Dengue cases were managed under the author's care in the entire 2022 and 2023 having not a single death, not even a DIC or hemorrhagic disorder. In certain cases minimum pulmonary edema happened yet those could be managed with care and without much difficulty. By virtue of maintaining normal hemoconcentration and intravascular volume as shock was prevented so were DIC, MISC like dangerous events too. The hospital stay was shortened and that to the extent that DF and DSS had the similar hospital stay. This could avoid use of IVIG, Methylprednisolone, any other steroid and Platelet transfusion.[13]

At the end of discussion, it would be worthwhile to mention that the current series showed the data of 44 cases here. However, to highlight here the revelation of current study, the important fact to uphold the point would be that the same principle was used to manage the Dengue affected children in entire 2022 and since the beginning of 2023 until now with the similar result and outcome of treatment although those cases numbering around 250 cold not be included here because of time constraints and planning. That must not make us to look to the issue with less importance. Again, considering the small size, single center study, purposive sampling, having no case control in this study, there are ample of scopes to conduct Double blind, multicenter, case-controlled study to come with stronger evidence that could draw the conclusion more convincingly.

Conclusion:

On the basis of the results and discussions in the current study the conclusion could be drawn that Albumin posed a risk factor as it went down below the critical level. It also was clear from the present study results and outcome of the treatment that showed no death, no DIC, no MISC, requiring no platelet, no IVIG, no methylprednisolone, no other steroid, no antibiotic to treat Dengue in children, neither in DF nor in DSS. Moreover, the DF patients with declining Albumin was administered Albumin and DSS could be prevented in almost all the cases. With it the note of conclusion could be drawn as shock can be prevented by judicious administration of Albumin in Dengue Fever in hospital admitted children.

Conflict of Interest: None

References:

1. Dengue-Bangladesh, WHO report, 11 Aug 2023
2. National Guideline for Clinical Management of Dengue Syndrome, 4th edition 2018
3. Ramakrishna M. A novel intervention altering disease course in children with dengue: an observational study.
4. Anon Srikiathkachon. Plasma Leakage in Dengue Hemorrhagic Fever. Thromb Haemost. 2009 Dec; 102(6): 1042-1049.
5. Muhammad AMK, Jackson T, Muhammad AUK, Safia A, Manickam A. Predictors of Hospital stay and mortality in Dengue virus infection- experience from Aga Khan University Hospital Pakistan. BMC Res Notes, 2014; 7: 473.
6. Marissa MA. Dengue Hemorrhagic Fever or Dengue Shock Syndrome in Children. BMJ Clin Evid. 2015; 2015:0917 (pub online 2015, Apr 10).
7. Zaman KA, Umair K, Hafiz IA, Sadia B, Hassan M, Saad BA, Javed A. Effectiveness of Platelet Transfusion in Dengue Fever: A Randomized Controlled Trial. Transfusion Medicine Hemother, 2013;40(5):362-368
8. Ranjit S, Ramanathan G, Ramakrishnan B, Kissoon N. Tangeted Interventions in Critically Ill children with Severe Dengue. Indian J Crit Care Med 2018;22:154-61.
9. Svajunas S, Johan B, Jane F, Bjorn PB, erik L, Carl MO, Palvi K, Bobby T, Peter B. Albumin Infusion Rate and Plasma Volume Expansion : A randomized Clinical Trial in Postoperative Patients and Major Surgery. Crit Care. 2019; 23:191. Pub online 2019 May 28.
10. Kabra SK, Jain Y, Ratagart VH. Dengue Hemorrhagic Fever: Clinnical Manifestations and Management. The Indian Journal of Pediatrics 66, 1999:93-101
11. Makrro RN, Raina V, Kumar P, Kanth RK. Role of Platelet Transfusion in the management of Dengue Patients in a tertiary Care Hospital. Asian J Transfus Sci. 2007 Jan-Jun;1(1):4-7.
12. Product Information. Albuminar-25(Albumin human).CSL Behring LLC. 2008.
13. Hankins J. The Role of Albumin in Fluid and Electrolyte Balance. Journal of Inf Nursing 29(5); Sep 2006: 260-265.