Original Research Article

DOI: http://dx.doi.org/10.18203/2349-3291.ijcp20194157

Thrombocytopenia in children 2 months to 12 years of age admitted in the paediatric intensive care unit of a tertiary care hospital

Jegan Murugan R., Manivannan V.*

Department of Paediatrics, Government Tiruvannamalai Medical College Hospital, Tiruvannamalai, Tamil Nadu, India

Received: 20 August 2019 Revised: 25 August 2019 Accepted: 29 August 2019

*Correspondence:

Dr. Manivannan V.,

E-mail: dr.manimmc@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: To assess the etiology, clinical profile, complications, outcome and prognosis of children admitted in the paediatric ICU with thrombocytopenia

Methods: This study was done on children admitted to the paediatric ICU of Tirunelveli Medical College Hospital during the period from December 2011 to April 2012. 112 consecutive patients aged 2 months to 12 years with platelet counts less than 1 lakh were studied.

Results: One in 6.25 children admitted in the paediatric ICU developed thrombocytopenia(15.95% incidence). The commonest age group of presentation of is 6-10 years(47.3%). Infants(45.5%) died more. Dengue(58.8%) was the commonest etiology, followed by enteric fever(11.6%), acute lymphoblastic leukemia (all 4.5%), septicemia(4.5%), plasmodium vivax malaria (2.7%). Leading cause of mortality is dengue shock syndrome(DSS 44.4%). The most common presenting symptom among the study group is fever(95.5%). Abdominal distension and pedal edema were significantly associated with low platelet counts, bleeding manifestations, increased transfusion needs and a poor outcome. The presence of Altered sensorium, tachycardia, tachypnea, shock, seizures at presentation were all associated with significant bleeding and high mortality. Gastrointestinal bleed(41.07%) was the commonest bleeding manifestation. There was no significant correlation between the exact platelet counts and the bleeding. Children with counts less than 10,000 had a poor outcome.(57.1% mortality). Gall bladder wall edema and pleural effusion in Ultrasound correlate significantly with bleeding.

Conclusions: Thrombocytopenia is common in sick children in paediatric ICU and has a definite bearing on prognosis. Infants have poor prognosis and need intensive monitoring. Mortality predictors, if present, need aggressive management. There is no role for prophylactic transfusions, as platelet counts do not correlate with bleeding.

Keywords: Dengue, Mortality predictors, Platelet transfusions, Thrombocytopenia

INTRODUCTION

Normal haemostasis is not only a complex but also an ingenious system which maintains blood in the vascular system free from clots, the vital element of the process being the platelet.¹ Decreased platelet count is not as common as anemia, the hematological cousin. Literature

quotes the incidence of thrombocytopenia to vary from 13 to 58% in various studies.² But it is far more dangerous and resource consuming to the emergency department and the ICU setting. It can be associated with bleeding ranging from minor bleeds to life threatening intracranial hemorrhage.

There is very often a poor correlation between the extent of thrombocytopenia and the severity of the bleed. Guidelines on platelet transfusions are also varied and confounding. Hence the treatment of thrombocytopenia has to be guided by an understanding of the cause and clinical course. It is often said that the main treatment goal in all patients with decreased platelet count is to maintain a safe platelet level so as to prevent significant bleeding. But what constitutes a safe count in a specific patient varies, depending on the etiology of the thrombocytopenia as regards to whether it is transient or chronic, as well as the patient's expected level of disease activity.³

There have been a plethora of studies on anemia and its impact various disease processes. on thrombocytopenia is still a grey area waiting to be explored. Again, there are lot of studies in the adult population detailing the outcome of patients with thrombocytopenia in the Intensive care setting.⁴ But similar studies in the paediatric age group are lacking. No particular study has been addressed towards studying the relative frequency of different disease conditions presenting as newly diagnosed thrombocytopenia in paediatric patients presenting to an Indian tertiary care hospital. The need arises to look at thrombocytopenia as a whole and to gather knowledge regarding the common disease entities presenting as thrombocytopenia, the clinical course in the hospital of patients presenting as such and whether or not active treatment modalities like platelet transfusions, steroids, platelets are required in them.

The present study was thus undertaken to evaluate the occurrence of thrombocytopenia, assess the cause for it and the associated mortality and morbidity in pediatric patients. In addition, the association with bleeding and the requirement of blood products was also studied.

METHODS

A descriptive, Cross sectional study Conducted on children who were admitted to the paediatric ICU of Tirunelveli Medical College Hospital during the period from December 2011 to April 2012. 112 consecutive patients who satisfied the following inclusion criteria were studied. The total number of admissions during the study period was 702.

Inclusion criteria

- The patients of both sexes aged 2 months to 12 years.
- Patients with platelet counts less than 1 lakh anytime during the course of hospital stay, irrespective of the cause for admission.

Exclusion criteria

Patients with spurious thrombocytopenia-lab induced errors

- Patients with established causes on treatment(e.g. known cases of haematological malignancies, aplastic anaemia, MDS, ITP).
- Patients who expired within few hours of admission.

Study protocol

Data regarding the patient was entered into present proforma as regards to the history, general and systemic examination, Hess test and vital signs. The bleeding manifestations and the course in hospital were recorded. Informed consent was obtained.

Following investigations were done for all patients: serial complete blood counts, peripheral smear for malaria, Blood sugar, urea, creatinine, serum bilirubin, liver enzymes, IgM dengue Elisa,NS1 Elisa and IgG dengue Elisa-were done twice on the day of onset and then as a convalescent sample, blood widal, urine culture, blood culture, chest x ray and ultrasound abdomen.

IgM, Elisa for leptospirosis, bone marrow study, Antinuclear antibodies, PT, APTT, hepatitis screening, CRP were done depending on the clinical scenario.

Once the specific diagnosis was reached, patients were treated for it specifically and symptomatically (Mechanical ventilation, shock correction, steroids). Blood products were transfused as per standard guidelines. Interventions to improve platelet count like platelet transfusion, steroids and the reason for such interventions were recorded.

Statistical analysis

Data was analysed using SPSS Version 16. Using this software, frequencies, percentages, means, standard deviations, chi square test, paired t test, unpaired t test correlation were applied. A 'p' value less than 0.05 is considered significant.

RESULTS

One in every 6.25 children admitted developed thrombocytopenia.(15.95% incidence). In 107 patients a definite cause for the thrombocytopenia could be identified, while 5 remained undiagnosed.

The commonest age group of presentation of thrombocytopenia is 6-10 years, constituting 47.3% of the cases. Mean age of presentation is 6.56 years(SD=3.49).

Mortality rate is highest among infants(45.5%).But this is not statistically significant(p>0.05). The mean age of expired children is 2.8 years which is statistically significant(p<0.05). 52.7% of the study population were girl children. There is no particular sex predilection for thrombocytopenia. The Male female ratio is 0.89:1.

In 86.6% of the patients, the platelet count improved prior to discharge and the thrombocytopenia was only transient.

The commonest etiology for newly diagnosed thrombocytopenia among children admitted is Dengue. Total dengue cases were 66,comprising 58.8% of the study population. Among the dengue cases, dengue fever

with or without hemorrhage(DF) was most common(32.1%). The second commonest diagnosis was enteric fever(11.6%). All 3 cases of malaria were due to Plasmodium vivax. All cases of leukemia were acute lymphoblastic leukemia(all). 4 cases were due to co infection with both dengue and enteric fever. 11 cases had rarer diagnosis like ITP, leptospirosis, hepatitis, snake bite. hemophagocytic syndrome. (Table 1)

Table 1: Etiology and disease wise mortality of thrombocytopenia.

Diagnosis	Frequency(n=112)	Percent	Death(n=8)	%
Dengue fever(DF)	36	32.1	0	0
DHF	21	18.7	0	0
DSS	9	8	4	44.4
Enteric	13	11.6	0	0
Dengue/enteric co infection	4	3.6	0	0
Malaria	3	2.7	0	0
ALL	5	4.5	0	0
Septicemia	5	4.5	2	40
Undiagnosed	5	4.5	0	0
Miscellaneous	11	9.8	2	18.2

Table 2: Clinical signs in the various diseases.

Features	Total n=112(%)	Dengue n=66(%)	Enteric n=13(%)	D/E n=4(%)	sepsis n=5(%)
ABD distension	28(25) p =0.001	16(24.2)	3(23)	1(25)	2(40)
ABD tenderness	18(16.1)	12(18.2)	3(23)	1(25)	0
Oliguria	15(13.4)	6(9.1)	2(15.4)	1(25)	3(60)
Puffy face	27(24.1)	16(24.2)	2(15.4)	0	2(40)
Pedal edema	11(9.8) p=0.006	6(9.1)	1(7.7)	0	0
Erythemaflush	54(48.2)	38(70.4)	5(9.3)	3(5.6)	1(1.9)

Table 3:Predictors of mortality in various diseases.

Features	Total n=112(% of n)	Death n=8(%)	p value outcome	Dengue deaths n=4(%)	Septicemia deaths n=2(%)
altered sensorium	49(43.8)	8(100)	0.001	4(100)	2(100)
tachycardia	48(42.9)	8(100)	0.001	4(100)	2(100)
tachypnea	20(17.9)	8(100)	0.000	4(100)	2(100)
shock	18(16.1)	8(100)	0.000	4(100)	2(100)
seizure	13(11.6)	3(37.5)	0.018	1(25)	2(100)
mech vent	7(6.3)	6(75)	0.000	2(50)	2(100)
inotrope	8(7.1)	7(87.5)	0.000	3(75)	2(100)
narrow pulse pressure<20	19(17)	2(25)	0.484	1(25)	1(50)
malnutrition	63(56.3)	1(12.5)	0.041	1(25)	0

Leading cause of mortality in the study population is dengue shock syndrome(DSS), causing 4 out of the 8 total deaths. DSS comprised only 8% of cases with thrombocytopenia, but had the highest mortality rate of 44.4%. The next leading cause of mortality was septicemia. 44.6% of the children presented with fever of

5-7 days duration. There is no correlation between early presentation and the outcome(p>0.05).

The most common presenting symptom among the study group is fever(95.5%) with vomiting being the second most common symptom(65.2%)..Abdominal pain and

tenderness was most common in dengue/enteric co infection while vomiting was most common among enteric fever cases.

outco

Abdominal distension and pedal edema were significantly associated with low platelet counts, bleeding manifastations, increased transfusion needs and a poor outcome(p<0.05).(Table 2)

Out of 76.1% of children with vomiting had bleeding manifestations. This is statistically significant(p=0.003).

Table 4: Comparison of radiological abnormalities.

Features	Total (n=112) (%)	p value	DF (n=36)	DHF (n=21)	DSS (n=9)	Enteric (n=13)
X ray eff/pneumonia	15(13.4)	0.002	1(6.6)	4(26.6)	1(6.6)	2(13.3)
Gall bladder edema	31(27.7)	0.001	0	11(52.4)	4(44.4)	8(61.5)
Pleural effusion	29(25.9)	0.008	0	15(71.4)	5(55.5)	4(30.7)
Ascites	18(16.1)	0.062	0	8(38.1)	3(33.3)	3(23.1)
Hepatomegaly	45(40.2)	0.338	10(27.8)	9(42.9)	3(33.3)	10(76.9)
Splenomegaly	27(24.1)	0.397	6(16.7)	5(23.8)	0	4(30.7)

Table 5: Profile of transfused children.

Parameter	No of children	n %
Children who received blood products	20	17.9%
Children who had bleeding	17	85%(p<0.05)
Mortality among transfused patients	6	30% (p<0.05)
Children with associated anemia	15	75%(p=0.001)
Lowest count for which transfused	7000	
Mean transfusion volume requirement	43.75 ml/kg/pa	atient
Mean count of transfused patients	24,000/L(p=0.	.038)
Major diagnosis for which transfused	DSS	
% of DSS patients transfused	77.8%	

In children with thrombocytopenia, the presence of Altered sensorium, tachycardia, tachypnea, shock at presentation, seizures were all significantly associated with high incidence of bleeding mortality(p<0.05). Children requiring inotrope support, mechanical ventilation also had poor outcome(p<0.05). The mortality was also significantly high(p<0.05)in malnourished children with thrombocytopenia .In fact ,the mean weight of the expired children was only 10kg compared to 17kg in survivors. Hence, all these factors are to be considered significant predictors of mortality. Narrow pulse pressure has not significantly affected the outcome. Occurence of seizures in cases with septicemia and thrombocytopenia had strong correlation with death(100%) ,probably indicating intracranial bleed.(Table 3)

Most patients at admission(45.6%) had a platelet count in the range of 50,000-1 lakh. Mean platelet count at admission was 61017 μ/L . Platelet trend analysis show a significant upward graph indicating that most thrombocytopenia was transient. Rather than the absolute values, it is the rate of drop in platelet counts which is associated with poor outcome.

Bleeding manifestations were seen in a total of 67 patients(59.8%).GI bleed was the commonest bleeding

manifestation associated with thrombocytopenia, seen in total of 46 patients.39.3% patients had malena,20.5% of children had hematemesis. 3.6% had more than one bleeding manifestation. Children with hematemesis had a significantly poor outcome(p=0.000) compared to children with malena(p=0.52).

The bleeding risk has been highest among children with platelet counts between 11,000-20,000 platelets. At counts lesser than 10,000 there has not been necessarily an increased % of bleeders. At higher counts, the percentage of bleeders is equally comparable(55.2% at counts between 21000-50000 and 52% at counts >50,000).so, there is poor correlation between the platelet counts and bleeding risk in the study group(p>0.05)

Children with counts between 11000-20000 had the highest number of bleeding manifestations(88.2%)followed closely by children with counts less than 10,000(71.4%). Children with severe thrombocytopenia less than 10,000 had a poor outcome. They constituted 50% of the total deaths and the mortality rate was 57.1%. The mortality was higher(80%) when children with counts less than 10,000 developed bleeding manifestations. The overall mortality among bleeders is 7.1%. But none of these findings are statistically significant .

Anemia and an increase in the erythrocyte sedimentation rate were the most common hematological abnormalities associated with thrombocytopenia. Children with anemia had a significantly poor outcome(p=0.008). The mean Hb in the discharged patients was 11.32gm% compared to 8.69gm% in children who expired(p=0.007). The other laboratory parameters did not significantly alter the outcome.

Abnormal X ray findings had a significant association with mortality(p<0.05). Ultrasound abdomen was able to pick up features of polyserositis with high sensitivity in both Dengue hemorrhagic fever and Dengue shock syndrome. But the findings were not specific for dengue alone. Even in enteric fever, pericholecystic edema with bladder thickening gall was consistent feature(61.5%).Gall bladder wall edema and pleural effusion in Ultrasound were seen in high frequency in This children with bleeding. is statistically significant(p<0.05).(Table 4)

72.9% patients who had low platelet counts were not given any transfusion and improved. This is statistically significant(p=0.007). Also patients with low admission platelet counts and also rapid drop in counts required more transfusions (p<0.05).25.4% of patients with bleeding manifestations were transfused(p<0.05). Among the bleeding manifestations, children with hematemesis and malena had a significantly increased need for transfusions(p<0.05). (Table 5)

There was also statistically significant association between need for transfusion and mortality(p<0.05). All the poor predictors of mortality also had significant association with the need for transfusions. Hence, it can be implied that transfusions have not significantly altered the outcome.

DISCUSSION

Thrombocytopenia, being associated with bleeding manifestations is now considered an independent parameter predicting outcome in the paediatric intensive care unit.⁵

Analysis of our study shows the highest incidence of thrombocytopenia in the 6-10 years age group, with a mean age of 6.56 years. The present study is comparable with Shahanaz et al, Lahore which reported 4-7 years as the commonest age group affected.^{6,7}

There is no particular sex predilection for thrombocytopenia. The male female ratio in the present study was 0.89:1 while Sachdev et al, reported 1.76:1 and Ali jan et al, reported 1.9:1. Such wide variations could be due to socio cultural differences.⁸

The incidence of thrombocytopenia has been quoted to vary from 13-58% in various studies. The present study has shown 15.95% incidence, which is comparable to

other studies; Sachdev et al showing 23.2% and 22% in a neonatal ICU study. 9,10

The present study had significantly a smaller number of children with counts less than 10,000 compared to Sachdev et al, (20%).But it is comparable in the other platelet ranges (15.2% between 11,000-20,000) to studies by Chandrakanta et al, (13.7%) and Mittal et al, Delhi(14.4%).^{6,9,10} (Figure 1)

Children with counts less than 10,000 had the worst outcome (57.1% mortality). Drop in platelet count >27% was significantly associated with mortality reported by Sachdev et al, which is comparable to the findings of the present study.⁶ Mortality in the present study was 7.1% with DSS contributing to 50% of the deaths. Krishnan et al reported 17.1% mortality, while Sachdev et al, reported a mortality of 10.9%. Mortality was highest among infants(45.5%) and younger children (<3 years). This is consistent with the observation by WHO that infants are prone for severe forms of the disease. The WHO observed case fatality rate in India is 3-5%. 11,12

DSS comprised only 8% of cases with thrombocytopenia but had the highest mortality rate of 44.4%. This could be attributed to the high baseline microvascular permeability in children.

Abdominal pain and vomiting were present in half to two-third of the patients in the present study which is consistent with other studies. Similar to other studies, platelet counts had no correlation to the bleeding manifestations in dengue. Majority of bleeding in the present study was observed in patients with counts more than 50,000. This confirms further that bleed in dengue is due to aberrant immunity and cross reactivity rather than an effect of the decrease in number. Indiscriminate platelet transfusions thus need to be avoided.

DSS cases with counts less than 10,000 have had a higher incidence of bleeding manifestations and mortality. Intensive monitoring and judicious fluid management may be needed to improve the outcome in such children.¹³

Gomber et al, defines 36.3% as the cut-off hematocrit for DHF. In the present study, the mean hematocrit among dengue patients was well above this cutoff, indicating high predisposition for development of severe dengue in the study group. Also, the hematocrit values are significantly associated with mortality. Unlike previous studies, the incidence of co infections in the present study was low (5.7%). The mortality rate among dengue patients as a whole was low(4/66=6.06%). 14

Hess test was positive in 16.9% of the children, mostly in children with counts between 10000- 20,000(58%).85.7% positivity was shown by Shigeki Hanafusa (Japan) et al.¹⁵

The low percentage in the present study(similar to another Indian study Narayanan et al)compared to foreign studies may be due to the difference in skin complexion and capillary fragility in Indian children. Hess test in the present study had significant association with bleeding.

The present study showed 63.9% NS1 positivity,84.8% IgM positivity and 48.5% showed fourfold rise of IgG. Comparatively a study in kuala lumpur Malaysia by Kassim et al, showed 32.2% NS1 positivity, 40.9% IgM and 36.1% IgG positivity. 16

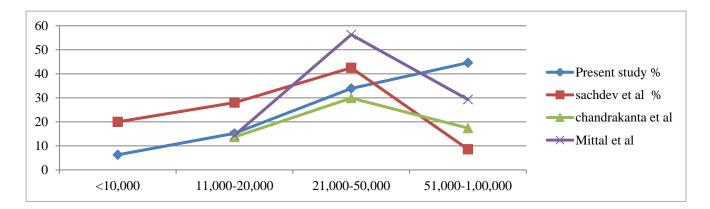


Figure 1: Comparison of platelet count trends between the various studies.

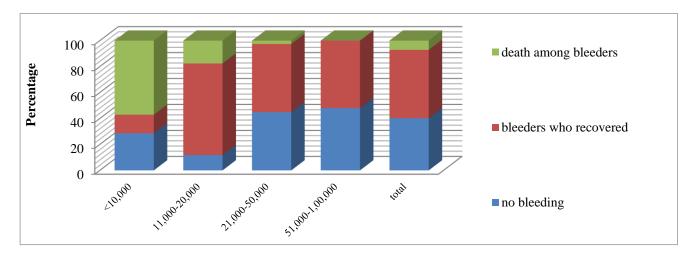


Figure 2: Bleeding manifestations under different platelet ranges and mortality among bleeders.

All three investigations were very useful in identifying both primary and secondary dengue infection. Triple positivity was seen in 36% of the cases. DHF had features suggestive of secondary infection.

Altered sensorium, tachycardia, tachypnea, shock(all having 100% association with death),requirement of inotrope support(87.5%),mechanical ventilation(70%), seizures, malnutrition were all significantly associated with increased mortality. Requirement of mechanical ventilation in Sachdev et al, 6 was 23.9% whereas in the present study, it was 6.3%. The incidence of shock was 17.3% in Sachdev et al, while in the present study it was 16.1%. In the study group, cases with seizures and thrombocytopenia had high mortality. This could probably be because of intracranial bleed induced by the thrombocytopenia. Abdominal distension and pedal edema were significantly seen in increased frequency in

children who expired. This could be probably because of plasma leakage associated with thrombocytopenia in dengue, and probable unidentified compartment syndrome. Hematemesis was also seen in significantly increased frequency in the expired children. Children with anemia also had a significantly poor outcome probably because they could not tolerate the bleeding.

Bleeding manifestations were seen in a total of 67 patients (59.8%) in the present study compared to 19.5% in Sachdev et al, there was significant association between vomiting, abdominal distension and bleeding. The overall mortality among bleeders is 7.1%. Bleeders with counts less than 10,000 had 87.5% mortality. But bleeding in thrombocytopenia was not significantly related to the platelet count or to the mortality. (Figure 2)

Inspite of several studies, evidence based guidelines for transfusions in children with thrombocytopenia are ambiguous, in most clinical situations, the treating physician is made to act on his own discretion rather than strictly follow guidelines.

Out of 7.9% children in the present study required transfusions. In comparison,21.9% patients were transfused in the study by Sachdev et al and transfusions were reported to be significantly associated with mortality.⁶ Most of the patients transfused in our study were DSS patients(77.8%). The mean platelet count of transfused patients was 24,000. Yet 80% mortality was seen in the transfused patients, which was also statistically significant. Patients with low platelet counts and bleeding manifestations also did not show statistically significant improvements in comparison to non-transfused patients.

Hence, the role of prophylactic platelet transfusions is to be questioned until uniform guidelines are established. WHO advises that platelet transfusions are to be avoided in dengue. The only clinical situation where platelet transfusion is needed in dengue is when the counts are less than 10,000.

In conclusion, it is to be said that studies on Thrombocytopenia, which is a common finding in the PICU setting, is a grey area. Dengue being the leading cause, judicious fluid management strictly following the WHO guidelines along with intensive clinical monitoring can go a long way in reducing mortality in this group of patients. Altered sensorium, tachycardia, tachypnea, shock, seizures, malnutrition, need for inotrope support and for mechanical ventilation are all predictors of mortality. Hematemesis and abdominal distension are significantly associated with mortality. They are warning signs and are to be given due importance as third space blood loss can go unnoticed and produce compartment syndrome. Intracranial bleed needs to be managed aggressively and appropriately. Hess test and hematocrit done early are sensitive in picking up cases prone for severe dengue and must be done in all cases. Chest X ray and Ultrasound abdomen are very sensitive in picking up polyserositis in DHF which must be done in all cases. Clinicians can be easily trained in performing an ultrasound and it is a comparatively cost effective diagnostic tool, which may be made mandatory in all secondary centres.

Transfusion of blood products have not significantly altered the outcome to a great extent. Also most thrombocytopenia was transient. Therefore, guidelines need to be followed while transfusing. It is prudent to treat the clinical presentation in the patient rather than treat the platelet numbers. There is no role for prophylactic transfusions, as platelet counts do not correlate with bleeding.

With the paucity of studies worldwide on paediatric thrombocytopenia, studies are required with larger number of patients in the pediatric age group to further consolidate the findings of the present study.

Limitations of the study includes; it was done during the seasonal period for infectious diseases. Hence incidence of infectious diseases might have been higher. Complete bleeding profile in the form of PT, APTT were not done for all the patients. Incidence of malaria is very low as the region is not an endemic area. Hence the data on malaria is subject to confounding.

ACKNOWLEDGEMENTS

The authors would like to thank the departments of biochemistry, microbiology, pathology of Tirunelveli Medical College, Tirunelveli, Tamil Nadu, India for their support. No other grant, aid, or monetary assistance was obtained from any source for conducting the study.

Funding: No funding sources Conflict of interest: None declared

Ethical approval: The study was approved by the

Institutional Ethics Committee

REFERENCES

- Cotran Kumar, Robbins. Pathological basis of disease. 8th ed. Philadelphia: W. B. Saunders company; 2010:115.
- 2. Strauss R, Hahn E. Thrombocytopenia in patients in the Medical Intensive Care Unit: . Crit Care Med. 2002;30(8):1765-71.
- 3. Deborah M. Consolini. Thrombocytopenia in Infants and Children. Pediatr. Rev. 2011;32(4);35-151.
- 4. Moreau D, Vesin A, Garrouste-Orgeas M, de Lassence A, Zahar JR, Adrie C, et al. Platelet count decline: an early prognostic marker in critically ill patients with prolonged ICU stays. Chest. 2007 Jun 1;131(6):1735-41.
- 5. Vanderschueren S, De Weerdt A, Malbrain M, Vankersschaever D, Frans E, Wilmer A, et al. Thrombocytopenia and prognosis in intensive care. Crit Care Med. 2000;28(6):1871-6.
- Agrawal S, Sachdev A, Gupta D, Chugh K. Platelet counts and outcome in the pediatric intensive care unit. Indian Journal of critical care medicine: peerreviewed, official publication of Indian Society of Crit Care Medicine. 2008 Jul;12(3):102-8
- 7. Muhammad Ali jan .Thrombocytopenia in children. J postgraduate Medical Institute, JPMI. 2004;18(3):353-8.
- 8. Roberts I, Murray NA. Neonatal thrombocytopenia: Causes and management. Arch Dis Child Fetal Neonatal Ed. 2003;88(5):359-64.
- Rashmi Kumar C, Jyotsana Agarwal G, Nagar R, Jain A. Changing clinical manifestations of dengue

- infection in north India. dengue bull, 2008;32;118-25
- 10. Mittal H, Faridi MM, Arora SK, Patil R. Clinico hematological profile and platelet trends in children with dengue during 2010 epidemic in north India. The Indian J Pediatr. 2012 Apr 1;79(4):467-71.
- 11. Krishnan J, Morrison W. Implications of thrombocytopenia and platelet course on pediatric intensive care unit outcomes., Pediatr Crit Care Med. 2008 Sep;9(5):502-5.
- 12. Comprehensive Guidelines for Prevention and Control of Dengue and Dengue Haemorrhagic Fever. Revised and expanded edition. World Health Organization. 2011.
- 13. Gamble J, Bethell D, Day NPJ, Loc PP, Phu NH, Gartside IB, et al. Age-related changes in microvascular Permeability: A significant factor in the susceptibility of children to shock? Clinical Science. 2000;98(2):211-6.

- 14. Gomber S, Ramachandran VG, Kumar S, Agarwal KN, Gupta P, Dewan DK. Hematological observations as diagnostic markers in dengue hemorrhagic fever-a reappraisal. Indian Pediatri. 2001 May;38(5):477-81.
- 15. Hanafusa S. Southeast Asian J Trop Med Public Health. March 2008:39(2).
- 16. Fauziah Md Kassim. Institute for Medical Research, Kuala Lumpur. Use of dengue NS1 antigen for early diagnosis of dengue virus infection;; Southeast Asian J Trop Med Public Health. May 2011:42(3).

Cite this article as: Jegan Murugan R, Manivannan V. Thrombocytopenia in children 2 months to 12 years of age admitted in the paediatric intensive care unit of a tertiary care hospital. Int J Contemp Pediatr 2019;6:2326-33.