Section A-Research paper

MORBIDITY AND MORTALITY PROFILE OF CHILDREN ADMITTED TO PAEDIATRIC INTENSIVE CARE UNIT (PICU)

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ABSTRACT

AIMS AND OBJECTIVE : To evaluate morbidity and mortality profile in children admitted to pediatric intensive care unit (PICU) and to assess the usefulness of PRISM III score in predicting mortality in PICU .

MATERIALS AND METHODS: It is a cross sectional,hospital based prospective observational study done in department of pediatrics , PICU, MKCGMCH,Berhampur from october 2019 to september 2021 taking 105 cases. Information collected on study population during admission to PICU included patient details, provisional diagnosis, primary system involved, PRISM III scoring[1](systolic BP, temp, heart rate, mental status, pupillary response, blood gas analysis ,glucose, potassium ,creatinine, hematological parameters) was done. Patient's course of hospitalisation in PICU was monitored and requirement of ventilator and type (invasive/ non invasive), duration were recorded. Final outcome was whether shifted to general ward / discharged/ death/ LAMA/ referral to higher centre was recorded. Statistical analysis was done between PRISM III score value and outcome of patients and discriminative power of the score between survivor and death was analysed.

RESULTS: Total 105 patients were analysed . most common age group was infancy and male to female ratio of 1.4:1. Most common indication for admission to PICU was respiratory diseases (n=38,36%)followed by neurological diseases(19,18%). Total death was (n= 27, 25%)among case studied.Among respiratory cases majority was pneumonia (n= 26, 68.4%). Total 63 cases (60%)

required assisted ventilation during PICU stay and among them 58.7% were on invasive mode of ventilation . Common indications for intubation was respiratory failure, shock and low GCS. Mortality rate among those on assisted ventilation due to respiratory causes was lower 21.9% as compared to neurological and cardiovascular causes with mortality rate of 57.1% each. Most common complication found in ventilated patients was nosocomial pneumonia 14.3%. Minimum PRISM III score in study was 0 and maximum was 42. Mortality risk among those with score 8 and below was (n= 63, 6.3%) and having score above 8 was (n= 42, 54.7%). Mortality risk was 100% when score was 30 and above. Area under the curve for PRISM III score was 0.91 (95% CI) reflecting good discriminative power of score between survivor and death.

Conclusion: Our study found that the mortality rate of PICU was 25% during the study period. A higher mortality rate was associated with more severe condition of patients during admission to PICU. PRISM III score was found to be an excellent predictor of mortality and had good discriminative power between survivor and death .

Keywords: PRISM III score, ventilator , outcome, predictor

INTRODUCTION

The pediatric intensive care unit (PICU) is a part of the hospital where critically ill pediatric patients who require advanced airway, respiratory, and hemodynamic supports are usually admitted with the aim of achieving an outcome better than if the patients were admitted into other parts of the hospital.[1]

The prediction of mortality risk by pediatricians is highly subjective (qualitative); therefore, there is a need for a scoring system (quantitative) for patients admitted to PICU. In 1988, Pollack et al. designed Paediatric Risk of Mortality (PRISM) score for prediction of mortality in PICU. It consisted of 14 variables .[2] PRISM was later modified to PRISM III with an addition of three variables by Pollack in 1996. PRISM III (17 variables) was tested among 11,165 patients in 32 PICUs across the USA and yielded better results than PRISM in predicting mortality.[3] Prediction of mortality can be assessed using 12 hours (PRISM III-12) or 24 hours (PRISM III-24) data. PRISM III-24 is more accurate for individual patient's mortality prediction, whereas PRISM III-12 is primarily used in qualitative studies.[3]

There was an meta analysis done using multiple studies of different countries including India about the predictive scoring system which reported sensitivity of 79% and specificity of 75% of PRISM III SCORE.[4]

Patients from southern Odisha & adjacent parts of Andra Pradesh depends on MKCG Medical college for treatment. Paediatrics Intensive Care Unit of MKCG Medical College and hospital started functioning since year 2018. It has a well equipped 10 beaded PICU. It has 6 functioning ventilators. Data of PICU in this part of the country is not available till date. Therefore, PICU data were analyzed and PRISM III score was utilised to find out the pattern of diseases and outcome at our centre which would help in modifying practices if necessary, leading to better management and outcome of critically ill children.

OBJECTIVES

To evaluate morbidity and mortality profile in children admitted to paediatric intensive care unit (PICU) and to assess the usefulness of PRISM III score in predicting mortality in PICU

MATERIALS AND METHODS

This cross sectional study , hospital based Prospective observational study was done in Department of Pediatric,MKCG Medical college, Berhampur from October 2019- September 2021.Institutional ethical clearance was taken for the study.The data collection was done as per designed proforma. Annually, 400-450 children are admitted in PICU, MKCGMCH, with a mortality rate of 30-35%. Consecutive samples are taken based on inclusion and exclusion criteria and for an expected sensitivity of 80% for PRISM III score to predict mortality, at least 105 patients need to be studied.

INCLUSION CRITERIA

All children between 1month to 14 years of age admitted to PICU in MKCG medical college and hospital

EXCLUSION CRITERIA

1. Patient who died within 24 hr of PICU admission
2. Patient who are shifted to general ward within 24 hr of PICU admission
3. Presence of major congenital anomalies and/orcomplex congenital cardiac lesion

STATISTICAL ANALYSIS

Statistical analysis was done using SPSS version 23.0. For qualitative variables, chi square test was used in the univariate analysis to observe the association between the study variables and the outcome. p value of < 0.05 is considered as significant.

The capacity for discrimination between a survivor and non-survivor was made using the area under the ROC curve. An area under the ROC curve of 0.75 or more was considered statistically significant.

RESULTS

The total number of cases included in study were 105. Out of which majority belonged to infancy group (42.8%). 41 were children(upto 10 year) and 19 were adolescents (>10 to 14 years). There were 62 males (59%)and 43 (40.9%) females in our study. The male to female ratio was 1.4:1.

Respiratory diseases (n=38, 36%) were major cause for admission to PICU, followed by neurological diseases (n=19,18%)followed by cardiovascular, septicemia, gastrointestinal, renal and hematological. Snake bite, scorpion sting, poisoning, DKA cases are included under others category due to few cases and specific nature.

TABLE 1: CLINICAL DIAGNOSIS AND MORTALITY ANALYSIS

CLINICAL DIAGNOSIS	NO. OF CASES	RECOVERY	RECOVERY%	DEATH	DEATH %
RESPIRATORY	38	31	81.5	7	18.4
CVS	11	7	63.6	4	36.3
CNS	19	14	73.6	5	26.3
SEPTICEMIA	10	8	80	2	20
HEMATOLOGICAL	4	1	25	3	75
RENAL	4	3	75	1	25
GI &HEPATOBILIARY	7	6	85.7	1	14.2
OTHERS	12	8	66.6	4	33.3
Total	105	78(74.3%)		27 (25.7%)	

Recovery percentage in diagnosis involving Gastrointestinal system, Respiratory were good above 80% on average while mortality rate among hematological system was high possibly due to terminal stage of hematological malignancy and unavailability of advanced treatment modality.

TABLE 2: ANALYSIS OF LENGTH OF STAY(LOS)

No Of Days in PICU	Total No Of Cases	Mortality	Mortality %
1-3	36(34.3%)	17	47.2%
4-6	52(49.5%)	5	9.6%
7-9	9(8.6%)	2	22.2%
>= 10	8(7.6%)	3	37.5%
Total	105	27	

Most of the cases stayed in PICU for 4-6 (n= 52,49.5%) with mortality rate of 9.6% whereas mortality percentage was 47.2% among those who stayed for only 1-3 days(n=36, 34.3%). Those who stayed for 10 days and more (n= 8, 7.6%) mortality rate was 37.5%. The average duration of stay for cases who recovered was 4.8 days and those who died was 4.3 days.

TABLE 3: CORRELATION BETWEEN PRESENCE OF SHOCK AND MORTALITY

SHOCK	Total	RECOVERY		DEATH		P value
		N	%	N	%	
Present	39(37.1%)	20	51.3	19	48.7	0.00
Absent	66(62.8%)	58	87.8	8	12.1	

Among 105 cases studied (n= 39,37.1%) presented with shock .It showed significant association between presence of shock and mortality with p value 0.00.

TABLE 4: TYPE OF ASSISTED VENTILATION

TYPE	NO OF CASES	PERCENTAGE
INVASIVE	30	47.6%
NON INVASIVE	26	41.3%
NIV f/b INVASIVE	7	11.1%
TOTAL	63	60%

In this study, total(n=63,60% of total patients) required assisted ventilation, among them 26 patients required non invasive ventilation by CPAP and rest 37 patients required invasive ventilation. Among

37 patients who required invasive ventilation, 7 patients, initial mode of ventilation was noninvasive and due course of illness required invasive mode of ventilation.

As per initial mode of ventilation, 33 patients required NIV, and 30 patients required invasive ventilation.

TABLE 5: PRIMARY SYSTEM INVOLVED AND NEED FOR ASSISTED VENTILATION (n=63)

PRIMARY SYSTEM INVOLVED	REQUIREMENT OF VENTILATOR	MORTALITY	MORTALITY %
Cardiovascular	7(11.1%)	4	57.1
Neurological	7(11.1%)	4	57.1
Respiratory	32(50.8%)	7	21.9
Gastrointestinal	0	0	
Hematological	2(3.2%)	2	100
Renal	1(1.6%)	1	100
Septicemia	4(6.3%)	2	50
Others	10(15.9%)	4	40
TOTAL	63	24	38.1%

Primary system involved in clinical diagnosis which required assisted ventilation was respiratory system (n= 32,50.8%)which had a mortality percentage of 22% . While neurological (n=7, 11.1%) and cardiovascular system (n=7;11.1%) involved had mortality percentage of 57% both.

TABLE 6: CORRELATION BETWEEN NEED FOR ASSISTED VENTILATION AND MORTALITY

Assisted Ventilation	Total	Recovery		Death		
		N	%	N	%	P value
Required	63	39	61.9%	24	38%	0.0003
Not Required	42	39	92.8%	3	7.1%	

When requirement of assisted ventilation was analysed statistically, there was a significant correlation with p value of less than <0.05.

The minimum PRISM score in this study was 0 and the maximum PRISM score was 42.The mean score was 9.37 and median is 6.The mode of PRISM III score was 5.Clustering of cases occurred in the region of 5 ,6.

TABLE 7: PRISM III SCORE AND MORTALITY

PRISM III SCORE	TOTAL NO OF PATIENTS	MORTALITY	MORTALITY %
0-9	67	5	7.4
10- 19	24	11	45.8
20 - 29	12	9	75
30 – 39	1	1	100
40 and above	1	1	100

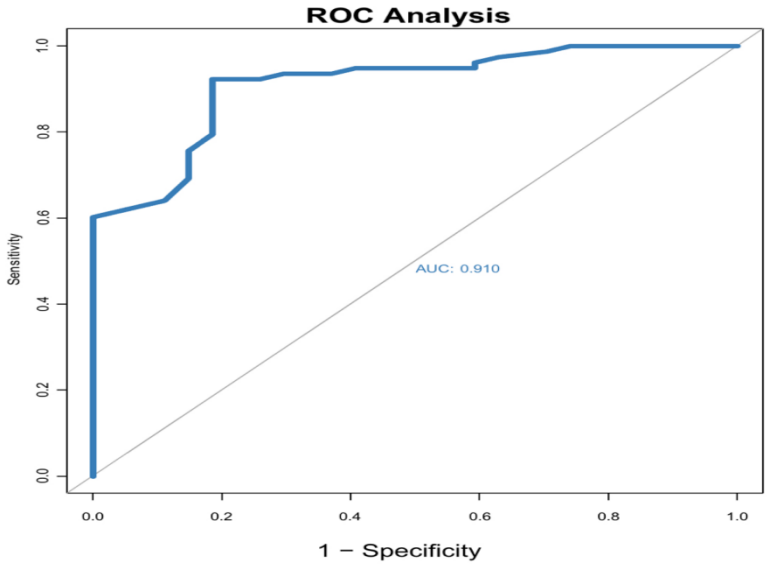
Mortality risk was found to be increasing with increase in the score. When the score was less than 10, the mortality risk was only 7.4%, while between 10 to 19 the risk was 45.8% which showed that there was a 6 fold increase in death risk. If the score was between 20-29, mortality risk increased to 75% and score above 30 had mortality risk of 100%.

TABLE 8: CORRELATION BETWEEN PRISM III SCORE AND MORTALITY

PRISM SCORE	RECOVERY		DEATH		
	N	%	N	%	**Odds ratio 17.9**
8 and below	59	93.6	4	6.3	**P value : 0.00**
More than 8	19	45.2	23	54.7	

; Analysis was done for the group which had score more than 8 and those who had 8 and below score . Those having score 8 and below had a mortality risk of 6.3% and those who have above 8 score had mortality risk of 54.7% which showed a p value of 0.00 which was statistically significant.

FIG 9: ROC(RECEIVER OPERATING CHARACTERISTIC) CURVE OF PRISM III SCORE



PRISM III score offered a good discriminative power between survivors and non survivors in our study with (AUC) area under the ROC curve as 0.91 (95% CI, 0.85,0.96). The area under the curve is a measure of the overall accuracy of the model as well as its ability to predict mortality. The closer the area under the ROC curve is to 1.0, the more accurate the model.

TABLE 9: UNIVARIATE ANALYSIS

	Odd's ratio	**95% confidence interval**	**P value**
GCS <8	16.9	5.9,47.8	0.00
Assisted Ventilation	8.0	2.2,28.7	0.00
PRISM score >8	17.9	5.4,58.1	0.00

For parameters like Glasgow Coma Scale, need for assisted ventilation, PRISM cut off 8, univariate analysis were done. All has p value of less than 0.01. PRISM score has highest odds ratio

than other two variables. Those who had PRISM score of more than 8 had about 18 times higher mortality risk than those with less than 8 score. Next to PRISM score those whose GCS score was <8 had 17 times higher mortality risk than those who had more than that. Patients who required assisted ventilation had 8 times more risk of mortality than those who did not.

TABLE 10: MULTIVARIATE ANALYSIS

	Adjusted Odd's ratio	**P value**
GCS <8	**1.39**	**0.00**
Requirement of ventilator	**1.17**	**0.02**
PRISM score >8	**0.77**	**0.00**

Risk factors which deemed to significantly contribute to mortality like PRISM III Score >8, GCS Score <8, need for assisted ventilation were analysed using logistic regression multivariate mode and all the three parameters were found to show statistical significance with the outcome.

DISCUSSION

In our study total 105 patients were analysed and out of them majority patients belonged to infancy age group that is n= 45 (42.8%) while adolescent constitute n= 19(18%) of study population and rest were within 1 to 10 years of age group n= 41 (39%). Finding was similar to the study by Haque and Bano *et al* .[5] Majority of study population were males n= 62 (59%) and females were n= 43 (40.9%) similar to study by Sahoo B *et al* [6] where 61.3% were male. Male to female ratio in this study was 1.4: 1 .

While admission into PICU, as per clinical diagnosis, the primary system affected by the disease process was identified and analysed. Respiratory illness was the commonest indication for admission into intensive care unit that is n= 38 (36%)followed by central nervous system n= 19(18%) and then cardiovascular system n= 11 (10%).Whereas study done by Sangeetha *et al* [7]done in a tertiary care hospital in south India , the most common disease category to which patients got admitted was cardiovascular system(41.1%) followed by neurological diseases(12%) and then by respiratory diseases(10%).

While many cardiovascular cases were admitted to PICU many were excluded from this study on basis of exclusion criteria as complex cardiac heart diseases have very bad prognosis and due to absence of facility for advanced surgical management, including these cases will falsely depict the mortality outcome and level of ICU care given.

Overall mortality in this study was (n= 27, 25%) giving an ICU survival rate of 75% which was higher than study by Rashma RP *et al*[8] where mortality rate was 10.58% and less than study done by Jyothi AK *et al* [9] mortality rate in PICU was 28% .study done by Bellad*et al* [10]mortality rate was 16.7%.The reported mortality varied from 9.8-35% in different series by other authors[11,12] . Among patients who died , majority were males (n=19,70.3%) whereas female were (n= 8, 29.6%) and the difference between mortality rate among both sex was little higher than finding obtained in the previous study like by Sangeeth, *et al.* [13]Still mortality rate in different sex were not statistically significant in our study , p value being 0.5.

Mortality rate was highest among patients admitted with hematological illness (n= 3 out of 4, 75%). Higher percentage may be due to less number of patients in that particular subgroup or can be due to disease process and terminal stage of illness. Next, cardiovascular system illness had mortality rate of (36.3%) followed by neurological diseases (26.3%). Diagnosis belonging to septicemia group had mortality rate of (20%) and respiratory illness had low mortality rate of 18.4%which may be due to availability of CPAP ventilation which are safe and very effective in those needing respiratory support.

Most common cause of death in our study was respiratory diseases (n= 7, 26%) followed by neurological diseases (n=5,18%), cardiovascular diseases (n=4,15%).Though mortality rate among respiratory cases were less as compared to other system , still due to majority of PICU admission were respiratory illness , so number of death due to respiratory illness was high among total death. It was similar to study done by Km *et al* where most common cause of death was respiratory system (38.8%).

Average duration of stay in PICU was 4.7 days ranging from day 1 to 25 days. The findings was similar to study by Khilnani *et al*[14]where average length of PICU stay was 4.52 +/−2.6 days. Those patients who died or transferred from PICU within 24 hours were excluded from the study. Most of the cases stayed in PICU for 4-6 days (n= 52,49.5% of total cases) with mortality rate of 9.6% whereas mortality percentage was 47.2% among those who stayed for only 1-3 days (n=36, 34.3%). Those who stayed for 10 days and more (n= 8, 7.6%) mortality rate was 37.5%. Duration of stay is important because serious and sever disease cases rapid and more mortality.

Mechanical ventilation is a standard of care in PICU, and our hospital being a Government hospital and a tertiary referral centre, many critically ill children who can be saved by assisted ventilation support are being referred to here. Among study population, 30 (28.5%) patients required invasive mode of ventilation during admission into PICU , whereas 33 (31.4%) patients required noninvasive mode of ventilation like CPAP. 7 patients among those who were on CPAP mode of ventilation, with due course of illness got intubated and put on invasive mode of ventilation. The commonest indication for assisted ventilation was respiratory diseases 32 (50.8%) followed by cardiovascular (11.1%) and neurological diagnosis (11.1%) which was similar to study done by Shanmugham G*et al* [15]where respiratory failure (82.4%) was the common indication for mechanical ventilation.The mortality rate among patients who received assisted ventilation was 38% whereas those who not required had mortality rate of 7.1%.

Most of the scoring systems have been well studied in adult intensive care unit but there are still very less number of study regarding scoring system in pediatric ICU. A variety of models exist for the prediction of mortality in patients of PICU, including the Pediatric Risk of Mortality (PRISM, PRISM III) and the Pediatric Index of Mortality (PIM and PIM 2) . Regardless, globally the PRISM III score is used more frequently and we decided to utilize it as well. In this study we used PRISM III score to predict mortality and was statistically analysed. The PRISM score obtained in our study was ranging from minimum 0 to maximum 42. The mean score was 9.4 and median score was 6 and mode was 5. Clustering of cases occurred in region of 5 and 6.

Mortality risk was found to be increasing with higher score value. Mortality risk was only 7.4% when score was less than 10 and it increased 6 fold around 45.8% when score was between 10 to 19. When the score was between 20 to 29 mortality risk was very high 75%.

When score was 30 and above, mortality risk was 100% in our study .In study done by Singhal D *et al* [12] PRISM score showed a significant association with the mortality. The proportion of deaths which was only 8.2% among children with the scores 1-9 showed a gradual increase with higher scores, reaching 66.7% among the children with a score of > 30 and it was similar to findings in this study. Another study by Bellad*et al* the proportion of the deaths was 5.3% with PRISM score of 1-9 and increased to 100% with scores of 20-29. The mean PRISM scores were lower insurvivors (6.5±3.6 Vs 15.5±7; P<0.001).With an increase in PRISM score by 1, the child's odds of

death increased by 36% (OR 1.36, 95% CI=1.24-1.5).Study done by Varma A *et al* [16] mortality rate in subgroup of PRISM III score of 0-5,6-10,11-15,16-20,21-25;26-30,31-35,36-40,40 and above were 0%,0%,3.3%, 41.6%,81.9%,89.3%,100%,94.4,100% respectively.

In previous studies cut off taken to predict high mortality risk was 8 and it was found that mortality risk among those having score 8 and below was 6.3% whereas having score beyond that had risk of 54.7%. When statistically analysed , it showed significant association of p value < 0.00 in this study and area under curve in ROC curve was 0.91 reflecting good discrimination score of PRISM III score between survivor and non survivor. Ability of a model can be assessed by estimating how close the ROC curve is to 1.0. Study done by Mirza S *et al*[17] also demonstrates that PRISM III acts as an excellent discriminative tool 0.903 area under the ROC curve. Bilanetal found that ROC analysis indicated a strong predictive power for the PRISM-III (area under the curve = 0.898) and the test was well fit to the designed study (goodness-of-fit p-value = 0.161).The observed short-term mortality rate was 9.05% and the expected mortality rate by the PRISM-III scoring was 9% reflecting a good predictive capacity. When associated factors were analysed for mortality risk assessment, presence of shock, having GCS score <8 and requirement for ventilation were found to have significant association with higher risk of mortality with p value < 0.00. While age group (infancy) and sex did not show any significant association with mortality risk.

CONCLUSION

Our study comprehensively investigated the morbidity and mortality profile of PICU of a tertiary care hospital. Our study found that the mortality rate of PICU was 25% during the study period. A higher mortality rate was associated with more severe condition of diseases during admission to PICU. PRISM III score was found to be an excellent predictor of mortality and had good discriminative power in our study. Associated factors like mechanical ventilation, presence of shock, low GCS score were associated with bad outcome. Using this prediction model we can assess the survival chances of patient and utilise available resources in best possible way specially in resource limited setting.

LIMITATIONS OF THE STUDY:

The validity of a score like a PRISM III will have to be observed by a multicentric trial which will allow for larger case mix and will represent better.Specific larger studies looking at particular disease states will be required to verify system-wise performance of the PRISM III score.Due to ongoing COVID-19 pandemic the demographic profile, distribution of diseases, mortality pattern may have been affected in this study.

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Table 1: Pediatric risk of mortality III score

Cardiovascular and neurologic vital signs	Findings	Points
Systolic blood pressure (mmHg)	Neonate and >55	0
	Neonate and 40-55	3
	Neonate and <40	7
	Infant and >65	0
	Infant and 45-65	3
	Infant and <45	7
	Child and >75	0
	Child 55-75	3
	Child and <55	7
	Adolescent and >85	0
	Adolescent and 65-85	3
	Adolescent and <65	7
Heart rate (beats/min)	Neonate and <215	0
	Neonate and 215-225	3
	Neonate and >225	4
	Infant and <215	0

	Infant and 215-225	3
	Infant and >225	4
	Child and <185	0
	Child and 185-205	3
	Child and >205 bpm	4
	Adolescent and <145 bpm	0
	Adolescent and 145-155 bpm	3
	Adolescent and >155 bpm	4
Temperature (°C)	<33	3
	33-40	0
	>40	3
Mental status	Glasgow coma score ≥8	0
	Glasgow coma score ≥8	0
Pupillary response	Both reactive	0
	One reactive and (1 fixed and >3 mm)	7
	Both fixed and both >3 mm	11

Acid‑base and blood gases	**Findings**	**Points**
Acidosis (mEq/L)	pH >7.28 and total CO2 ≥17	0
	pH 7.0-7.28 or total CO2 5-16.9	2
	pH<7.0 or total CO2 <5	6
pH	<7.48	0
	7.48-7.55	2
	>7.55	3
PCO2 (mmHg)	<50	0
	50-75	1
	>75	3
Total CO2 (mEq/L)	≤34	0
	>34	4
PaO2 (mmHg)	≥50	0
	42.0-49.9	3
	<42	6

Chemistry tests	**Findings**	**Points**
Glucose (mg/dL)	≤200	0
	>200	2
Potassium (mEq/L)	≤6.9	0
	>6.9	3
Creatinine (mg/dL)	Neonate and ≤0.85	0

	Neonate and >0.85	2
	Infant and ≤0.90	0
	Infant and >0.90 mg/dL	2
	Child and ≤0.90 mg/dL	0
	Child and >0.90 mg/dL	2
	Adolescent and ≤1.30 mg/dL	0
	Adolescent and >1.30 mg/dL	2
BUN (mg/dL)	Neonate and ≤11.9	0
	Neonate and >11.9	3
	Not neonate and ≤14.9	0
	Not neonate and >14.9	3

Hematologic tests	**Findings**	**Points**
White blood cell count (/μL)	≥3000	0
	<3000	4
Platelet count (/μL)	>200,000	0
	100,000-200,000	2
	50,000-99,999	4
	<50,000	5
PT and PTT	Neonate and PT ≤22 s and PTT ≤85 s	0
	Neonate and (PT >22 s or PTT >85 s)	3
	Not neonate and PT ≤22 s and PTT ≤57 s	0
	Not neonate and (PT >22 s or PTT >57 s)	3