Original Research Article

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Assessment of the utility of Yale observation scale as a predictor of bacteremia in children aged 3 months to 36 months

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ABSTRACT

Background: The Yale observation scale (YOS) is an illness severity helps to diagnose bacteremia based on simple noninvasive clinical signs and symptoms. The aim of the present study was to assess the utility of YOS as a predictor of bacterial infection in febrile children aged 3 to 36 months.

Methods: This prospective observational study was conducted on 200 children aged 3 to 36 months presenting with fever, at the Institute of Child Health and Hospital for Children during the period from April 2016 to September 2016. Rectal temperature was taken for all children. Clinical examination was done as required based on the YOS and scores were given accordingly at the time of initial presentation of the child before invasive investigations. All the observation was assessed statistically and receiver operating characteristics (ROC) curve was performed to analyze the sensitivity of the YOS.

Results: Highly significant correlation (p=0.0001) was found to exist between the age of the child, duration of the fever, higher body temperature >104, WBC count, ANC and improved condition of patient with higher YOS. ROC curves showed that the sensitivity and specificity of YOS at the best cut off value of 14.5 was found to be 97% and 79.6% respectively.

Conclusions: YOS is very good tool for predicting bacteremia in young febrile children based on simple non-invasive clinical signs and symptoms. The findings ruled out by YOS aids in the immediate and early management of bacterial infections before the arrival of the results of the biochemical diagnostic tests.

Keywords: Febrile children, Bacteremia, Yale observation scale

INTRODUCTION

Fever is one of the commonest illnesses among pediatrics. In infants it is significant to differentiate the bacterial and non-bacterial causes of fever due to high incidence of viral infections at that particular age. In fact, sometimes the fever may be due to bacteremia even in absence of confining signs. Untreated bacteremia worsens the health condition that may lead to death of the infant. Hence early diagnosis and treatment of bacteremia reduces the incidence of sequelae of the bacterial

infections, i.e., the motor, sensory and mental deficits, the visual and auditory handicaps caused by bacterial meningitis in infants and scarring of the renal tissues caused by UTI including pyelonephritis leading to chronic kidney disease, joint and bone deformities caused by septic arthritis and osteomyelitis and thereby reduces the infant mortality rate during febrile conditions.³

Yale observation scale (YOS), is an observational scale consisting of 6 observational items originally characterized and clubbed by McCarthy et al in 1982 and

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validated in young febrile children (<24 months, N= 165) to detect a serious illness. It is simple, quick, easy to apply and cost-effective, and does not contain investigational items.⁴

Previous studies investigated the importance of YOS in validating the febrile condition in infants, but no significant correlation was noted among the patient characteristics and the YOS. Hence the present study was done with the aim to consider the utility of Yale observation score (YOS) as a significant predictor of bacterial infection in febrile children aged 3 months to 36 months attending the institute.

METHODS

This was a prospective observational study conducted in the Institute of Child Health and Hospital for Children, Chennai, during the period from April 2016 to September 2016. After getting approval from Institutional ethics committee a total of 200 children aged 3 to 36 months presenting with fever, admitted in the medical wards of ICH&HC were included in the study. Informed consent was taken from all the parents of included study population.

Inclusion criteria

• Infants aged 3 months to 36 months who were found to have a rectal temperature greater than or equal to 100.4-degree Fahrenheit were included in the study.

Exclusion criteria

- Children with recorded a temperature of more than 100.4-degree Fahrenheit.
- Patient is a known case of immunodeficiency states, arthritis, autoimmune diseases, connective tissue disorders, chronic illnesses, tumors, vasculitis, familial neutrophilia,
- History of having received parenteral antibiotics, sedatives within 24 hours of presentation, antipyretics within 8 hours of presentation, CNS depressants, opioids, steroids, quinidine
- History of being treated in other hospitals prior to our hospital visit
- History of having received immunization within 48 hours of presentation.

Method of recording temperature in the infant

Temperature was measured after performing a thorough hand wash. A standard rectal thermometer was used for the measurement of temperature in the study population. Rubbing alcohol was used to clean the thermometer.

It was ensured that the thermometer was cleaned every time before and after it was being used on an infant. The rectal thermometer was inserted up to 2 to 3 cm above the anal verge in the most cautious manner not disturbing the

state of the child. Temperature was noted down immediately from the thermometer after the beep sound as per the recommendation from the manufacturers of the digital thermometer. All readings were recorded in the unit of Fahrenheit.

Clinical examination was done as required based on the Yale Observation Scale (YOS) and scores were given accordingly at the time of initial presentation of the child before invasive investigations or the administration of drugs if any.

The skin of the child overlying a prominent peripheral venous site was identified and sterilized with spirit. A 24-gauge needle was used to draw 1 ml of venous blood by venipuncture.

The samples were collected in an EDTA containing vacutainer. The samples obtained were sent to the Pathology laboratory of ICH and HC for the analysis of WBC and ANC using the semiautomated counter, Sysmex KX 21NTM Automated Hematology Analyzer.

The child's course in ward and further diagnostic investigations, especially culture and sensitivity of the body fluids like urine, blood and CSF, substantiating the bacterial infections strongly were noted during follow up. Final diagnosis with which the child was managed, duration of stay in hospital and the final outcome of the patient including improvement or death was noted down.

Statistical analysis

Descriptive statistics was done for all data and were reported in terms of frequency mean values and percentages.

The Chi square test was performed to find out the correlation between the YOS and the various factors that could affect it with respect to the febrile children. Receiver operating characteristics (ROC) curve was performed to analyze the sensitivity of the YOS as an initial screening test and to find the best possible cut off with the highest possible sensitivity.

All data were entered in a Microsoft excel sheet and was imported to SPSS software. All analyses were performed using SPSS software (Statistical Package for Social Sciences) version 20.0.

RESULTS

Two hundred infants were enrolled in the study group who had a rectal temperature of more than or equal to 100.4 Fahrenheit. Data from these 200 infants were used for various analysis and interpretations. In the present study, majority (99) had a YOS score between 6-12 (49.5%). 71 (35%) of children had a score between 13-18, 24 (12%) had a score between 19-24, the rest of the 6 patients had a score between 25-30 (3%) (Figure 1).

The percentage of children included were studied in terms of distribution age, sex, temperature recorded, duration of fever, duration of hospital stay and final outcome of the patients. The final YOS scores, divided into various ranges were compared with the demographic

parameters, biochemical parameters of WBC count, absolute neutrophil count (ANC) and the culture reports of the body fluids showing evidence of a bacterial infection (Table 1).

Table 1: Distribution of study population according to the findings of the study and their correlation with YOS scores.

Variables	Yale observation score (YOS)				Total (n=200)	P value
	6-12 (N=99)	13-18 (N=71)	19-24 (N=24)	25-30 (N=6)		
Sex						
Female	55	39	15	3	112	0.910
Male	44	32	9	3	88	
Age (in months)						
3-6	7	22	6	2	37	
7-12	16	19	10	3	48	
13-18	10	8	4	1	23	0.0001**
19-24	12	9	2	0	23	
25-30	24	5	0	0	29	
31-36	30	8	2	0	40	
Temperature in F	ahrenheit		'		'	
100.4-101	38	4	0	0	42	0.0001**
101.1-102	35	13	0	0	48	
102.1-103	22	17	3	0	42	
103.1-104	4	27	10	2	43	
>104	0	10	11	4	25	
Duration of fever	in days					
1-2	19	2	1	0	22	0.0001**
2-3	42	7	1	0	50	
3-4	27	28	2	0	57	
4-5	11	22	11	5	49	
>5	0	12	9	1	22	
WBC count per m	ım³					
<15000	77	13	0	0	90	0.0001**
>15000	22	58	24	6	110	
ANC per mm ³						
<10000	84	13	0	0	97	0.0001**
>10000	15	58	24	6	103	
Culture evidence	of bacteria in bo	dy fluids				
Positive	0	17	20	6	43	0.0001**
Negative	99	54	4	0	157	
Duration in days						
≤7	88	39	2	2	131	0.0001**
8-14	11	26	13	1	51	
>14	0	6	9	3	18	
Outcome	•					
Improved	98	70	19	0	187	0.0001**
Expired	1	1	5	6	13	

Two patients with temperature between 103.1 to 104 F showed a YOS score of 25-30 and 4 of the patients with a temperature >104F were observed to have a YOS score of greater than 25-30 (p=0.0001). None of the children who had fever less than 4 days and 6 children who had

fever more than 4 days had a YOS score greater than 19 and its relation with duration was significant statistically (p=0.0001). None of the children whose WBC counts were less than 15000 had a YOS score of greater than 19. And among 110 the children who had a WBC count of

greater than 15000, almost half of the patients (58) had a score between 13-18, 24 patients had a score between 19-24. Hence it is very witnessed that as the child with fever showed a score of more than 13 the incidence of bacterial infection is increased (p=0.0001).

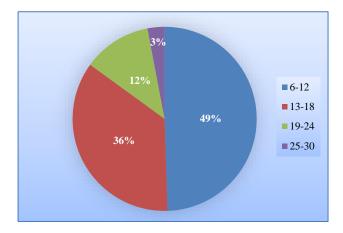


Figure 1: Distribution of study population as per YOS

Among the 97 children who had a count of less than 10000 the majority (N=84), showed a YOS score between 6-12. Of the 103 children with a count of greater than 10000, 58 (56.3%) had a score between 13-18, followed by the next major group of children with a score between (N=24)19-24, followed by 15 children with a score between 6-12 and 6 children with a score between 25-30. Hence bacteremia is understood to be present when the score is greater than 13.

Among the study population, 43 had a positive culture in any of the body fluids like blood, urine or CSF. Of these 43 patients, 20 had a YOS score between 19-24, 17 had a score between 13-18, 6 had a score between 25-30. Among the 157 children with negative cultures none had a score between 25-30. Majority of the negative culture was present in the children with a score between 6-12.

Among the 200 patients studied, 131 were discharged from the wards in less than a week. Of them, majority (N=88) of the children had a score of 6-12, 39 had a score between 13-18. A total of 51 patients had to stay in the hospital between 8 to 14 days. Of this, majority (N=26) showed a YOS score between 13-18. And out of the 18 children who had a hospital stay of more than 14 days 9 children had a score between 19-24.

Among the 187 children who improved and were sent home, 98 had a YOS score of 6-12, 70 had a score of 13-18, 19 had a score between 19-24. 13 patients out of the 200-study population, a significant number of children (N=6) belonged to group who had a score 25-30 followed by the next high score between 19-24 (N=5), among the expired patients. Receiver operating characteristic curves (ROC) obtained by plotting sensitivity on Y-axis against (1-specificity) on X-axis for each of the cut off values of

YOS scores showed that the point on the ROC curve nearest to top left corner (where sensitivity and specificity both are 1 or 100%) corresponded to the best cut off of 14.5 gives a sensitivity of 97% and a specificity of 79.6%. The next best cut off is 15.5 which gives sensitivity of 93% and a specificity of 80% and the cut off of 17 has sensitivity of 74% and a specificity of 92.4% (Figure 2).

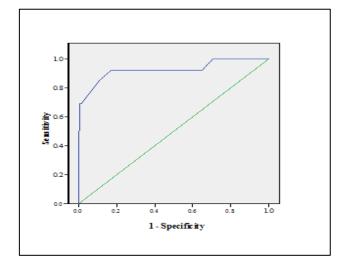


Figure 2: ROC curve.

DISCUSSION

In this era of antibiotics, there prevails a common tendency of the treating physician to prescribe an antibiotic, which is partly due to the fear of missing a bacterial infection and partly may also be due to the anxiety of the parents who tend to gain information about the use of antibiotics in case of fever from various other sources. Hence it becomes a compulsion to differentiate a bacterial and nonbacterial cause of fever at the presentation of a child to the pediatrician to prevent the irrational and unnecessary use of antibiotics.

Various criteria, scales and scores have been designed to estimate, at least approximately, the probability of bacterial infection in a febrile child. While many criteria are based on both physical and biochemical analysis of febrile children, the Yale Observation Scale which is purely based on the clinical examination of the child at the initial presentation of the child.⁴

Fever in infants less than 3 months of age is always considered ominous and hence is treated promptly without delay. Due to the mental and physical immaturity of this group of infants the clinical signs expected to satisfy the YOS. The children aged more than 3 years of age have adequate physical and mental development that they tend to obviate their discomfort, for e.g. Dysuria in case of a UTI or pain in a joint in case of arthritis. Hence the age group of children between 3 to 36 months has become the main target of serious bacterial infections. The study included 200 patients aged 3 months to 36

months, admitted in the wards of ICH and HC, who had a rectal temperature of >100.4F and who satisfied the inclusion and the exclusion criteria. YOS was applied after a thorough physical examination. Though, culture is the gold standard, ANC, WBC count give a reliable evidence of bacterial infection. Hence ANC and WBC counts were taken as markers of bacteremia.^{2,5,6}

In the present study, a significant correlation was found between the age of the younger child and higher YOS score. This was in contrast to the findings of previous study done by Baker et al. According to them, YOS is not significant in predicting the bacteremia in a young infant below 8 weeks of age.⁷

The observations of the current study also observed that higher temperature >104, duration of fever and WBC count greater than 15,000 an ANC greater than 10000 and a positive culture of body fluids had significant correlation with the YOS score. Theses observation were similar to the findings of other studies.⁷⁻⁹

YOS also correlates well with the outcome of the child, i.e., as the score goes higher the mortality seem to increase and vice versa. This was in accordance with the findings of Walia et al.¹⁰

In present study, the sensitivity and specificity of YOS at the score of 14 was 97% and 79.6% respectively. These observations make the YOS a sensitive tool in predicting bacteremia and hence considered as useful initial screening scale to predict the risk of bacteremia in a febrile child. This was in accordance to the findings of Bang et al. Their findings revealed that the best cut off value for YOS score was >10 for prediction of bacteremia.² In another study by Walia et al, the cut off value of YOS score was taken at ≥20 and noticed the 100% sensitivity and NPV with lower specificity of 90%.

CONCLUSION

The findings of the study emphasize the role of Yale observation in the febrile children as a useful predictor of bacteremia and the early initiation of antibiotics in suspected cases before the arrival of investigation reports. The YOS is very simple, easy, and cost-effective screening tool for assessing the overall clinical appearance of febrile child at the outpatient level.

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Ethical approval: The study was approved by the

Institutional Ethics Committee

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