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EVALUATION OF RISK STRATIFICATION FOR INDICATORS OF A POTENTIALLY DANGEROUS BACTERIAL INFECTION IN ORDER TO FORECAST NEWBORN DEATH

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ABSTRACT

Background: One of the leading reasons of newborn death is PSBI (possible severe bacterial infection). PSBI is separated according to clinical disease and serious infection indicators based on WHO data. By evaluating PSBI symptoms, newborns can be categorized into risk categories for proper care and prognosis.

Aim: The purpose of this study was to evaluate the risk stratification of indicators of a potentially severe bacterial infection in order to predict death in babies ages 0-59 days.

Methods: 440 newborns exhibiting symptoms of a potentially dangerous bacterial illness were evaluated for this investigation. These newborns, who ranged in age from 0 to 59 days, were split into two groups: those who showed symptoms of critical illness (CI) and Group II had subjects with signs of CSI (clinical severe infection). Each sign of PSBI was assessed for the correlation with mortality. Time of death was assessed using Kaplan Meier survival analysis.

Results: 440 newborns were evaluated for illness outcomes. High death rates of 9% and 20% were linked to severe chest pain and low body temperature in CSI symptoms, whereas low mortality rates were linked to movement only upon stimulation, poor eating, rapid breathing, and fever. Convulsion, no movement at all, and no eating at all were linked to high death rates of 14%, 63.7%, and 47.4%, respectively, in relation to CI symptoms. Most fatalities were made public within 48 hours.

Conclusion: Low body temperature, chest discomfort, and any indications of a significant bacterial infection are characteristics of newborns with a high death risk. Risk stratification based on clinical indicators can further lower infant death rates by prioritizing infants in need of immediate care.

Keywords: Convulsions, infants, mortality, sepsis, possible serious bacterial infection

INTRODUCTION

The number of deaths for every 1000 live births that occur before the first birthday is known as the infant mortality rate, or IMR. It is an essential measure of a population's health. Between 1990 and 2019, the IMR decreased globally from 64.5 to 28.2. India's IMR in 2021 was 28.7%, which is a 3.61% decrease from 2020. Sepsis, prenatal problems, low birth weight, and preterm, with regional variations, are responsible for about 80% of newborn deaths. The leading cause of death and organ failure worldwide, sepsis encompasses meningitis, pneumonia, osteomyelitis, arthritis, urinary tract infections, and septicemia. Sepsis is classified as either early-onset or late-onset based on the time at which symptoms appear.¹ In neonatal sepsis, early risk factor identification can reduce baby morbidity and death.

In low and middle-income nations, 99% of fatalities are caused by infections, and unspecific indications and symptoms, a lack of awareness, restricted access to healthcare, and poor transportation can all cause delays in receiving the right medical care. Clinical sign identification can aid in the prediction of serious disease based on WHO data.²

For such evaluations, PSBI (potential serious bacterial illness) is advised. This includes convulsions, significant chest indrawing, fever ($\geq 38^{\circ}\text{C}$), hypothermia (temperature $< 35.5^{\circ}\text{C}$), poor eating, movement only upon stimulation, and quick breathing (≥ 60 breaths per minute). The World Health Organization recommends injectable antibiotics for newborns with PSBI under 59 days of age, and for all except seriously sick neonates, injectable gentamycin for two days, followed by oral amoxicillin for five days or oral amoxicillin for seven days.³⁻

When referrals are not practical, WHO advises outpatient treatment. Signs of CSI (clinical severe infection) and CI (critical illness) are two categories for sepsis symptoms. PBSI indicators are further divided into two categories: indicators of low mortality risk and indicators of high mortality risk. Compared to OPD therapy, infant mortality with low-risk indications was greater in hospitals; hence, community-based/outpatient management of these newborns became a potential.⁴

When developing health care policies in India, the stratification of PSBI symptoms might be useful in determining if community-based therapy of these babies is feasible. In low-middle-income countries (LMICs) with limited resources, this will be crucial in lessening the load of hospital subjects.^{5.}

MATERIALS AND METHODS

By comparing the symptoms of CI and CIS with mortality and time to death following hospital presentation, the current study sought to evaluate the risk stratification of PBSI (potential severe bacterial infection) in young babies aged 0-59 days admitted to an Indian healthcare institution. To evaluate risk stratification of indications of a potentially significant bacterial infection (PBSI) in the prediction of death in young babies aged 0-59 days, a prospective clinical trial was conducted. The research participants were selected from the Institute's pediatric department. All subjects gave their written and verbal informed permission prior to their involvement in the study.

440 newborns, ages 0 to 59 days, who presented to the pediatric emergency room exhibiting one or more PSBI symptoms were included in the research. The symptoms of PSBI were further divided into those of CI, which included convulsions, no movement, and instability when feeding, and CSI, which included severe chest indrawing, temperature $< 35.5^{\circ}\text{C}$, temperature $\geq 38^{\circ}\text{C}$, poor feeding on observation, movement only when stimulated, and rapid breathing. Clinical professionals with expertise in the subject kept an eye on and recognized these indicators. The research excluded newborns with significant congenital abnormalities, weight less than 1500 g upon entrance, and those in need of exchange transfusions or surgery.

A clinical staff at the hospital evaluated and treated the study babies based on their clinical signs and symptoms, using normal unit standards. For laboratory analysis, samples were obtained for CRP (C-reactive protein), blood culture, urine microscopy/cultures, and chest X-rays in patients with respiratory conditions. In order to evaluate the examination and history of meningitis beyond the newborn period, meningitis characteristics, and late-onset sepsis in neonates, CSF (cerebrospinal fluid) was analyzed using culture, biochemistry, and cytology.

As suggested by the participants' clinical status, supportive care and intravenous antibiotics are administered as respiratory support measures such ventilation, CPAP, or oxygen treatment. Blood product transfusions were administered for platelets, FFP (fresh frozen plasma), and PRBS in accordance with the pediatrician's transfusion protocols. The evaluation of results was done up until the point of death or discharge. Resolving the underlying ailment, tolerating breastfeeding or full oral feeds, finishing intravenous antibiotics, and inhaling room air within the last 48 hours were all requirements for discharge.

The data gathered were analyzed statistically using SPSS (Statistical Package for the Social Sciences) software version 24.0 (IBM Corp., Armonk, NY, USA). The p-value of < 0.05 was considered statistically significant.

RESULTS

Assessing risk stratification of indications of a potentially severe bacterial infection (PBSI) in the prediction of death in young babies aged 0-59 days was the goal of the current prospective clinical trial. 440 newborns who showed symptoms of a potentially dangerous bacterial illness were evaluated in this research. These newborns, who were between the ages of 0 and 59 days, were split into two groups: Group I included CI (critical illness) indicators, and Group II contained CSI (clinical severe infection) signs. There were 35% (n=154) of subjects aged 0-7 days, where 94.8% (n=146) survived and 5.2% (n=8) died; 40% (n=174) of subjects aged 8-28 days, where 94.2% (n=164) survived and 5.8% (n=10) died; and 25% (n=112) of subjects aged 29-59 years, where 94.6% (n=106) survived and 5.4% (n=6) died.

With $p > 0.05$, the difference was not statistically significant (Table 1). The current study included 49% ($n=214$) male individuals and 51% ($n=226$) female subjects. According to the risk stratification of CSI signs for predicting mortality in young infants, 410 subjects did not exhibit low body temperature, with 95.6% ($n=392$) surviving and 4.4% ($n=18$) dying, while 30 subjects did, with 80% ($n=24$) surviving and 20% ($n=6$) dying. With $p=0.01$, the difference was statistically significant. Among the 184 patients with poor feeding, 97.8% ($n=180$) survived and 2.2% ($n=4$) died; among the 256 subjects without poor feeding, 92.2% ($n=236$) survived and 7.8% ($n=20$) died; this difference was not statistically significant ($p=0.07$). Fever, quick breathing, severe chest indrawing, and movement upon stimulation alone were likewise non-significant in both present and missing CSI signs ($p=0.34, 0.33, 0.51$, and 0.09 , respectively) (Table 2).

In terms of risk classification of CI signals for predicting mortality in early newborns, the study's findings revealed that 22 individuals exhibited no movement at all, with 36.4% ($n=8$) surviving and 63.6% ($n=14$) dying. There was absolutely no movement in 418 individuals, of whom 97.6% ($n=408$) lived and 2.4% ($n=10$) perished. $p < 0.001$ indicated that the difference was extremely statistically significant. In 38 individuals, there was no feeding at all, resulting in 52.6% ($n=20$) subjects surviving and 47.4% ($n=18$) subjects dying; in 402 subjects, 98.5% ($n=396$) subjects survived and 1.5% ($n=6$) subjects died.

The difference was statistically significant with $p < 0.001$. Convulsions were present in 100 subjects where 86% ($n=86$) subjects survived and 14% ($n=14$) subjects died. 340 participants did not have convulsions; 97.15% ($n=330$) of these subjects lived, whereas 2.9% ($n=10$) of them died. This difference was extremely statistically significant ($p=0.006$) (Table 3).

Additionally, the risk stratification of low body temperature and indications of critical illness was shown in the prediction of time to death; children with one or both of these indicators had considerably higher mortality rates than newborns with other signs of CSI. Kaplan Meier survival analysis was used to determine the mean time of death, which ranged from 48 to 32 hours from the time of hospital admission. Most of the recorded fatalities occurred within 48 hours after admission.

DISCUSSION

In this study, 440 newborns who showed symptoms of a potentially dangerous bacterial illness were evaluated. These newborns, who were between the ages of 0 and 59 days, were split into two groups: Group I included CI (critical illness) indicators, and Group II contained CSI (clinical severe infection) signs. There were 35% ($n=154$) of subjects aged 0–7 days, where 94.8% ($n=146$) survived and 5.2% ($n=8$) died; 40% ($n=174$) of subjects aged 8–28 days, where 94.2% ($n=164$) survived and 5.8% ($n=10$) died; and 25% ($n=112$) of subjects aged 29–59 years, where 94.6% ($n=106$) survived and 5.4% ($n=6$) died. Table 1 shows that the difference was statistically non-significant with $p > 0.05$. The study's volunteers were 49% ($n=214$) male and 51% ($n=226$) female.

In their separate investigations, Wang ME et al. (2016) and Tshefu A et al. (2015) evaluated participants with PSBI and collected demographic data similar to the current study. These data were comparable to those of their studies.

According to the study findings, low body temperature was observed in 30 subjects, of whom 80% ($n=24$) survived and 20% ($n=6$) died, and it was not observed in 410 subjects, of whom 95.6% ($n=392$) survived and 4.4% ($n=18$) died, when using risk stratification of CSI signs to predict mortality in young infants. The difference, $p=0.01$, was statistically significant. In 184 individuals, 97.8% ($n=180$) survived and 2.2% ($n=4$) perished due to inadequate feeding; in subjects that were not fed, there were 256 subjects where 92.2% ($n=236$) survived and 7.8% ($n=20$) subjects died which was non-significant with $p=0.07$. Fever, quick breathing, severe chest indrawing, and movement upon stimulation alone were likewise non-significant in both CSI sign present and missing instances ($p=0.34, 0.33, 0.51$, and 0.09 , respectively). The present study's findings were in line with those of Bassani D8 (2014) and Seale AC et al. (2010), who also indicated low body temperature as a risk factor of CSI in people with PSBI. In terms of using CI indicators for risk stratification in predicting mortality in early newborns, 22 cases showed no movement at all, with 36.4% ($n=8$) surviving and 63.6% ($n=14$) dying. There was absolutely no movement in 418 individuals, of whom 97.6% ($n=408$) lived and 2.4% ($n=10$) perished.

402 patients, of whom 98.5% ($n=396$) lived and 1.5% ($n=6$) died, were absent from feeding, whereas 38 subjects, of whom 52.6% ($n=20$) survived and 47.4% ($n=18$) died, did not get any feeding at all. $p < 0.001$ indicated that the difference was statistically significant. 100 patients had convulsions; 86 (86%) of them survived, while 14 (14%), of them, perished. Of the 340 individuals, 97.15% ($n=330$) survived and 2.9% ($n=10$) died; the absence of convulsions was extremely statistically significant ($p=0.006$). These results were in line with those of Chu SM et al. (2014) and Singer M et al. (2016), who found that convulsions, no movement at all, and no eating at all were CI indicators that predicted younger infants' deaths.

Infants with one of the signs of CSI or one sign of CSI as low body temperature had significantly higher mortality rates compared to infants with other signs of CSI, according to the study's findings, which also demonstrated the impact of risk stratification of signs of critical illness and low body temperature in predicting time to death. The Kaplan Meier survival analysis was used to determine the average time of death, which ranged from 48 to 32 hours from the time of hospital admission. Within 48 hours after arrival, most of the recorded fatalities occurred. These findings were consistent with research by Rosa-Mangeret F et al. (2013) and Liu L et al. (2012) where authors reported that According to the current study's findings, most PSBI fatalities occurred within 48 hours.

CONCLUSION

Within its limits, the current study comes to the conclusion that newborns with low body temperature, chest discomfort, and any indications of a significant bacterial infection have a high death rate. Infant mortality rates can be further decreased by prioritizing newborns that need immediate assistance through risk classification based on clinical symptoms. To draw a firm conclusion, more extensive longitudinal research with longer tracking periods and bigger sample numbers is required.

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TABLES

S. No	Age (days)	Total	n (%)	Survived n (%)	Mortality n (%)	p-value
1.	0-7	308	154 (35)	146 (94.8)	8 (5.2)	>0.05
2.	8-28	348	174 (40)	164 (94.2)	10 (5.8)	
3.	29-59	224	112 (25)	106 (94.6)	6 (5.4)	

Table 1: Distribution of study subjects based on their age

S. No	Signs of CSI	Total	Survived		Mortality		p-value
			n	%	n	%	
1.	Low body temperature						
a)	Present	30	24	80	6	20	0.01
b)	Absent	410	392	95.6	18	4.4	
2.	Poor feeding						
a)	Present	184	180	97.8	4	2.2	0.07
b)	Absent	256	236	92.2	20	7.8	
3.	Movement on stimulation only						
a)	Present	80	78	97.5	2	2.5	0.34
b)	Absent	360	338	93.9	22	6.1	
4.	Severe chest in drawing						
a)	Present	66	60	90.9	6	9.1	0.33
b)	Absent	374	356	95.2	18	4.8	
5.	Fast breathing						
a)	Present	146	140	95.9	6	4.1	0.51
b)	Absent	294	276	93.9	18	6.1	
6.	Fever						
a)	Present	286	276	96.5	10	3.5	0.09
b)	Absent	146	140	95.9	6	4.1	

Table 2: Risk stratification of CSI signs for predicting mortality in young infants

S. No	Signs of CI	Total	Survived		Mortality		p-value
			n	%	n	%	
1.	No movement at all						
a)	Present	22	8	36.4	14	63.6	<0.001
b)	Absent	418	408	97.6	10	2.4	
2.	No feeding at all						
a)	Present	38	20	52.6	18	47.4	<0.001
b)	Absent	402	396	98.5	6	1.5	
3.	Convulsions						
a)	Present	100	86	86	14	14	0.006
b)	Absent	340	330	97.1	10	2.9	

Table 3: Risk stratification of CI signs for predicting mortality in young infants