Development and Evaluation of a Screening Tool for Bacteremia in Neonates

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ABSTRACT

BACKGROUND: The diagnosis of neonatal sepsis is hindered by the high false negative rate of blood cultures. Clinical and laboratory parameters can aid the decision of when to obtain blood cultures; however, current prediction models have poor accuracy and efficacy.

OBJECTIVES: To develop a screening test for bacteremia in neonates using common laboratory and clinical parameters and determine sensitivity and specificity values.

METHODS: A retrospective chart review of neonates admitted to a Level 2 neonatal intensive care unit (NICU) between March 15, 2012 and January 14, 2015 and a prospective evaluation of all neonates admitted to the same NICU between January 15, 2015 and March 30, 2015 were completed. Bacteremic neonates (cases) were compared to non-bacteremic neonates (i.e. neonates who did not have a positive blood culture).

RESULTS: Maximum blood glucose, maximum heart rate, maximum neutrophils and bands were identified as the best predictors of bacteremia. A positive blood culture with bacterial load > 10^4 CFU/mL was identified as the best threshold to identify neonates at highest risk of late onset bacteremia in whom a blood culture should be obtained.

CONCLUSION: The screening tool incorporates simple clinical and laboratory parameters that are readily available.

METHODS

Study Setting and Design:

A retrospective chart review of neonates admitted to the Sunnybrook Health Sciences Centre (SHSC) NICU between March 15, 2012 and January 14, 2015 and a prospective evaluation of all neonates admitted to the same NICU between January 15, 2015 and March 30, 2015 were completed. Patients were identified for inclusion using the WPRO database of the Sunnybrook Antimicrobial Stewardship Program.

Diagnosis of Bacteremic Neonates:

Bacteremic neonates (cases) were compared to non-bacteremic neonates (i.e. neonates who did not have a positive blood culture at any time during their NICU stay) to determine if predictors of late onset bacteremia in neonates could be identified. A maximum of 48 hours of antibiotic exposure immediately following birth was allowed for non-bacteremic controls; however, only neonates who were exposed to greater than 48 hours of antibiotics during their stay were excluded from the study.

Definitions:

Bacteremic neonates were defined as those with a positive blood culture in whom antimicrobials were begun. Neonates with blood isolates of possible bacterial pathogens were excluded (e.g. Pseudomonas aeruginosa, Propionibacterium spp, and Bacillus spp [other than B. anthracis]).

RESULTS

A positive blood culture with Coagulase negative staphylococci was deemed a contaminant if the colony count was > 100 colonies/cm^2. These isolates were clinically well and therefore did not receive a course of antibiotics. If neonates had multiple positive blood cultures during their NICU stay, data was only collected in relation to their first positive blood culture.

Late onset bacteremia (LOB) was defined as the development of bacteremia >3 days after admission to the NICU.

Sample Size:

A total of 513 neonates (41 cases, 45 matched controls and 75 unmatched controls) were included in this study. Traditionally, the evaluation of an association between independent variables and a dependent variable requires: patient: variable ratios from 2 to 1.01 with a minimum sample size of 100-200 patients considered acceptable sample size for variable assessment. Thus, a sample size of 513 patients would allow an assessment of association of at least 15 to 76 variables at a patient: variable ratio of 101:1 and 2:1 respectively.

Our results provided seven parameters that were significantly associated with late onset bacteremia in neonates and developed a model that significantly outperformed currently published tools.

The model incorporated simple clinical and laboratory parameters and provided a positive predictive value (PPV) of 89.9% and negative predictive value (NPV) of 99.0%

Four parameters were associated with bacteremia: maximum blood glucose, maximum heart rate, maximum neutrophils and bands

Our findings provide a highly sensitive and specific tool for the identification of neonates at high risk of late onset bacteremia.

Development of a novel screening tool for the identification of late onset bacteremia

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REFERENCES