

Absolute Band Counts in Febrile Infants: Know Your Laboratory

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ABSTRACT. It was the impression of 1 of the authors that band counts in febrile infants ≤ 60 days of age were much higher as reported from the clinical laboratory at Children's Hospital Medical Center of Akron, Ohio, than they had been at Strong Memorial Hospital in Rochester, New York. Absolute band counts (ABC) from 119 febrile infants ≤ 60 days of age seen in the emergency department of Children's Hospital Medical Center of Akron for whom blood culture results were known were obtained retrospectively and compared with results from a prospective study conducted in Rochester. In Akron, 45% of the infants had elevated band counts and 16% had no other risk factor for serious bacterial infection compared with 5.9% and 1.4%, respectively, in Rochester. The ABC can vary widely from laboratory to laboratory. The clinician must use caution when using the ABC as a criterion for identifying infants at low risk for serious bacterial infection. *Pediatrics* 2002;110(1). URL: <http://www.pediatrics.org/cgi/content/full/110/1/e12>; febrile infants, absolute band counts, low risk criteria, serious bacterial infection, bacteremia.

ABBREVIATIONS. SBI, serious bacterial infection; ABC, absolute band count; ED, emergency department; CHMCA, Children's Hospital Medical Center of Akron; WBC, white blood cell; NPV, negative predictive value; CI, confidence interval.

The Rochester Criteria were developed to identify infants ≤ 60 days of age with fever (rectal temperature $\geq 38^\circ\text{C}$) who are at low risk for serious bacterial infection (SBI).^{1,2} To be included in the low-risk group, an infant must have an absolute band count (ABC) $\leq 1500/\text{mm}^3$. When 1 of the authors (K.R.P.) moved to Akron, Ohio, it was his impression that many more infants in Akron were being excluded from the low-risk group solely on the basis of an elevated ABC than had been the case in Rochester.

The purpose of this study was to compare the numbers of infants who would be excluded from the low-risk group solely on the basis of an elevated ABC in Akron with those who were excluded in Rochester.

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METHODS

A list of all patients who were evaluated in the emergency department (ED) at Children's Hospital Medical Center of Akron (CHMCA) after January 1, 1998, and had a complete blood cell (CBC) count was compiled alphabetically from the clinical laboratory database. ED records were reviewed to identify infants ≤ 60 days of age, with fever (rectal temperature $\geq 38^\circ\text{C}$) or history of fever, for whom blood culture results were available. These infants comprised the study group. The age, sex, white blood cell count (WBC), ABC, blood culture results, and diagnosis were recorded for all patients.

Automated CBC counts were done in the hematology laboratory using the Cell Dyn 3500 blood analyzer (Abbott Laboratories, Abbott Park, IL). A manual differential count was performed when the total WBC count was $< 4000/\text{mm}^3$ or $> 20\,000/\text{mm}^3$, the neutrophil count was $\geq 70\%$, the lymphocyte count was $\geq 60\%$, or if the analyzer "flagged" immature WBCs. Patients from whom band counts were not done were assumed to have band counts $< 1500/\text{mm}^3$. After identifying all infants with ABC $\geq 1500/\text{mm}^3$, a subgroup with WBC counts between $5000/\text{mm}^3$ and $15\,000/\text{mm}^3$ were reviewed further to determine whether infants would have been excluded from the low-risk group by Rochester criteria other than an elevated ABC.

Data Analysis

The percentages of all infants with an elevated ABC, elevated ABC with WBC counts between $5000/\text{mm}^3$ and $15\,000/\text{mm}^3$ (normal WBC), and elevated ABC with normal WBC count and no other risk factors from the Akron and Rochester data sets were compared. Using the Rochester data set, the negative predictive value (NPV) of the Rochester Criteria was recalculated from the original data set using and excluding the ABC as a criterion.

RESULTS

Review of ED records from the first 281 infants in the alphabetized list from the clinical laboratory identified 119 infants who met inclusion criteria for the study. Band counts had been performed on 86 of the 119 infants. Band counts were $\geq 1500/\text{mm}^3$ in 53 (45%) of 119 infants compared with 54 (5.9%) of 918 from the Rochester data set ($P < .001$). The ABC was $\geq 1500/\text{mm}^3$ in 27 Akron patients with a WBC count between 5000 and $15\,000/\text{mm}^3$ compared with 20 patients in Rochester ($P < .001$). Eight of the 27 patients with elevated ABC and normal WBC counts failed to meet 1 or more additional Rochester Criteria. Thus, a total of 19 (16%) of the 119 infants in Akron would have been excluded from the low-risk group based solely on an elevated ABC. This compares with 13 (1.4%) of 918 infants in Rochester ($P < .001$). The NPVs of the Rochester criteria for both SBI and bacteremia with 95% confidence intervals (CIs) were recalculated from the original data set excluding the ABC as a criterion. The recalculation resulted in a NPV for any SBI of 98.3% (95% CI: 97.5%–99.1%) compared with the original NPV of 98.9% (95% CI: 98.2%–99.6%). The recalculated NPV for bacteremia

was 99.4% (95% CI: 98.8%–99.9%) compared with the original NPV of 99.6% (95% CI: 99.1%–99.9%).

DISCUSSION

The results of this study leave no doubt that band counts in febrile infants ≤ 60 days of age are much more likely to be elevated at CHMCA in Akron, Ohio, than they are at Strong Memorial Hospital in Rochester, New York. In Akron, 45% of febrile infants ≤ 60 days of age for whom CBC counts and blood culture results were known had ABCs $\geq 1500/\text{mm}^3$ compared with 5.9% in Rochester. If using the Rochester Criteria to identify infants at low risk for SBI, even more important is the finding that 16% of infants seen in Akron would have been excluded from the low-risk group solely on the basis of the ABC as compared with 1.4% in Rochester. The conclusion is obvious: band counts can vary significantly from one laboratory to another.

Faced with these data, we investigated technical factors that might account for the discrepancy noted. Reproducibility of band counts is known to be influenced by the number of cells counted in the differential and the morphologic definition of a band neutrophil.³ In the data we were evaluating, standard 100-cell differential counts were the basis for band enumeration, so differences in morphologic criteria seemed the most likely source of variation. Definitions of a segmented neutrophil vary from a “neutrophil with nuclear constriction to less than one third the width of a lobe (the definition used in Rochester),” to the strictest definition requiring “nuclear lobes be connected by only a thin filament with no discernable chromatin.”⁴ CHMCA uses the strictest definition and, therefore, it has a much higher reference range for bands (up to $1800/\text{mm}^3$ in patient with WBC counts in the upper normal range), whereas Rochester’s less strict definition results in reference ranges for bands considerably $<1500/\text{mm}^3$.

Given this variation-based band definition, what is the importance of ABC? A number of investigators have questioned the usefulness of the ABC in evaluating patients for SBIs,^{5–7} and others have supported its use.^{2,8} We asked how the operating parameters of the Rochester Criteria would change if the ABC was omitted from the criteria. Without the ABC

as a criterion, the NPV for any SBI decreases by 0.6% and the NPV for bacteremia decreases by 0.2%. Statistically, the difference does not seem large. However, the incidence of SBI in young infants is low. In the Rochester data set² there were only 5 instances of SBI, including 2 infants with bacteremia out of 437 infants who met the low-risk criteria. Had the ABC not been used as a criteria, there would have been 3 additional instances of SBI, including 1 infant with bacteremia. In Akron, 1 infant with group B streptococcal bacteremia would have been excluded from the low-risk group solely on the basis of the ABC. Based on these findings, we concluded that ABC does add to the utility of the Rochester Criteria.

Clearly, clinicians need to be aware of the definition of segmented neutrophils used in their laboratory when using the Rochester Criteria. Laboratories that use a strict definition of segmented neutrophils will have a higher reference range for band counts, and many more infants will be excluded from the low-risk group solely on the basis of an ABC $\geq 1500/\text{mm}^3$. How and if the ABC could be modified to account for varying definition has not been defined. It is our opinion that excluding too many infants from the low-risk group would be better than missing infants with SBI.

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