analesdepediatría

www.analesdepediatria.org

ORIGINAL ARTICLE

Construction of a diagnostic prediction model of severe bacterial infection in febrile infants under 3 months old☆

Enrique Villalobos Pinto*, **Marciano Sánchez-Bayle**

Sección de Pediatría Hospitalaria, Servicio de Pediatría, Hospital Infantil Universitario Niño Jesús, Madrid, Spain

Received 7 April 2016; accepted 14 February 2017
Available online 3 November 2017

KEYWORDS
Serious bacterial infection;
Fever;
Positive cultures;
Less than 3 months old;
C-reactive protein;
Procalcitonin;
Rochester criteria

Abstract
Introduction: Fever is a common cause of paediatric admissions in emergency departments. An aetiological diagnosis is difficult to obtain in those less than 3 months of age, as they tend to have a higher rate of serious bacterial infection (SBI). The aim of this study is to find a predictor index of SBI in children under 3 months old with fever of unknown origin.
Methods: A study was conducted on all children under 3 months of age with fever admitted to hospital, with additional tests being performed according to the clinical protocol. Rochester criteria for identifying febrile infants at low risk for SBI were also analysed.

A predictive model for SBI and positive cultures was designed, including the following variables in the maximum model: C-reactive protein (CRP), procalcitonin (PCT), and meeting not less than four of the Rochester criteria.
Results: A total of 702 subjects were included, of which 22.64% had an SBI and 20.65% had positive cultures. Children who had SBI and a positive culture showed higher values of white cells, total neutrophils, CRP and PCT. A statistical significance was observed with less than 4 Rochester criteria, CRP and PCT levels, an SBI (area under the curve [AUC] 0.877), or for positive cultures (AUC 0.888). Using regression analysis a predictive index was calculated for SBI or a positive culture, with a sensitivity of 87.7 and 91%, a specificity of 70.1 and 87.7%, an LR+ of 2.93 and 3.62, and a LR− of 0.17 and 0.10, respectively.
Conclusions: The predictive models are valid and slightly improve the validity of the Rochester criteria for positive culture in children less than 3 months admitted with fever.

☆ Please cite this article as: Villalobos Pinto E, Sánchez-Bayle M. Creación de un modelo probabilístico de diagnóstico de infección bacteriana grave en lactantes febriles de 0 a 3 meses de vida. An Pediatr (Barc). 2017;87:330–336.

* Corresponding author.
E-mail address: evillalobospinto@gmail.com (E. Villalobos Pinto).

PALABRAS CLAVE
Infección bacteriana grave;
Fiebre;
Cultivos positivos;
Menores de 3 meses;
Proteína C reactiva;
Procalcitonina;
Rochester

Creación de un modelo probabilístico de diagnóstico de infección bacteriana grave en lactantes febriles de 0 a 3 meses de vida

Resumen
Introducción: La fiebre es motivo frecuente de consulta pediátrica y en menores de 3 meses su diagnóstico etiológico es difícil, siendo un grupo de pacientes con mayor tasa de infección bacteriana grave (IBG). Nuestro objetivo es encontrar un modelo predictivo de IBG en menores de 3 meses con fiebre sin foco.
Métodos: Se estudió a los niños menores de 3 meses con fiebre sin foco ingresados, realizándose pruebas complementarias según protocolo clínico. Se analizaron además los criterios de Rochester de bajo grado de IBG. Se diseñó un modelo predictivo de IBG y cultivo positivo, incluyendo las siguientes variables en el modelo máximo: proteína c reactiva (PCR), procalcitonina (PCT) y cumplimiento o no de menos de 4 criterios de Rochester.
Resultados: Se incluyó a 702 sujetos; el 22,64% presentaba IBG y el 20,65% cultivos positivos. Los que presentaban IBG y cultivo positivo presentaron más leucocitos, neutrófilos totales, PCR y PCT. Se obtuvieron significación estadística en puntuación de Rochester menor de 4 y valores de PCR y PCT para IBG (área bajo la curva [ABC] 0,877) y para cultivos positivos (ABC 0,888). Con la regresión se obtuvieron unas fórmulas de predicción de IBG y cultivo positivo con sensibilidad del 87,7 y el 91%, especificidad del 70,1 y el 87,7%, CPP de 2,93 y 3,62 y CPN de 0,17 y 0,10, respectivamente.
Conclusiones: Los modelos predictivos son válidos y mejoran discretamente la validez de los criterios de Rochester para cultivo positivo en menores de 3 meses ingresados con fiebre.

Introduction

Fever is one of the main reasons for paediatric medical visits, accounting for 10–20% of emergency department visits.[1]

In the field of paediatrics, fever is of greater significance due to the particular characteristics of the patients, the frequent nonspecificity of presenting symptoms in severe infections, and the anxiety that it produces in families and even in health professionals. These factors grow exponentially in young infants, especially those aged less than 3 months—the focus of our study—in who the diagnosis of a potential severe bacterial infection has more serious therapeutic and prognostic implications.

Fever is usually a manifestation of infection, but in infants *aged less than 3 months*,[1] non-infectious aetiologies are more frequent and clinical diagnosis is usually challenging. Fever in these patients tends to be milder, but its presence may be a manifestation of severe disease. We ought to pay particular attention to the subset constituted by newborns (aged less than 4 weeks), who are considered a high-risk group, as up to 1/8 of those presenting with fever may have a severe bacterial infection (SBI). The most frequent causative agents in this age group are β-haemolytic group B streptococci (*Streptococcus agalactiae*), *Enterobacter* species (especially *Escherichia coli*) and *Listeria monocytogenes*.

The primary *objective* of our study was to develop an index for the prediction of SBI in infants aged less than 3 months with fever of unknown origin, including clinical features and laboratory tests for acute phase reactants. Furthermore, we sought to establish the ideal cut-off point after which it would be possible to recommend antibiotic treatment fairly reliably and advance the appropriate use of empiric antibiotherapy.

Participants and methods

We conducted a prospective study of 5 years' duration in infants aged 0 to 3 months that visited the emergency department with fever of unknown origin of 38 °C or higher who, following emergency department protocols based on the recommendations of the Asociación Española de Pediatría (Spanish Association of Paediatrics), underwent microbiological testing and were admitted to hospital. We defined fever without source of short duration as fever whose aetiology remained unknown after a careful history taking and physical examination (PE) and with onset in the past 72 h. In adherence with clinical protocols, all patients with a diagnosis of SBI received antibiotic treatment.

A complete blood count with measurement of C-reactive protein (CRP) and procalcitonin (PCT) levels and collection of samples for microbiological testing—blood culture, urine culture (catheter specimen) and stool culture (in case of gastrointestinal manifestations)—were performed in all patients, and analysis of cerebrospinal fluid (following protocol) in 302 patients (43.01%).

We considered the following to be SBIs[1]: urinary tract infection, occult bacteraemia, meningitis, pneumonia, bacterial gastroenteritis, septic arthritis, osteomyelitis and soft tissue infection.