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ORIGINAL ARTICLE

Population-based incidence of community-acquired pneumonia hospitalization in Hong Kong children younger than 5 years before universal conjugate pneumococcal immunization

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Objectives: We sought to document the incidence of pediatric hospitalization for bacterial pneumonia before universal childhood conjugate pneumococcal vaccination using two different methods of diagnosis.
Methods: By following the World Health Organization (WHO) chest radiography (CXR) protocol, two radiologists independently read the CXRs of a cohort of systematically recruited children younger than 5 years. The children had acute respiratory infections and were admitted to one of two hospitals that care for 72.5% of all pediatric admissions on Hong Kong Island. Medical records were reviewed for clinical manifestation and to identify bacterial pneumonia diagnosed by pediatricians.
Results: In children younger than 5 years, the incidences of bacterial pneumonia, as diagnosed by pediatricians and by the WHO CXR standard, were 775.7 per 100,000 population [95% confidence interval (CI, 591.8—998.3)] and 439.5 per 100,000 population (95% CI, 304.6—614.5), respectively. The study period was from 2002 to 2004.

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Conclusion: This study provided a reliable baseline estimate of the hospitalization burden of pneumococcal pneumonia in Hong Kong children before the advent of universal conjugate pneumococcal vaccination.

Introduction

Pneumonia causes significant morbidity in children. *Streptococcus pneumoniae* is the leading cause of bacterial pneumonia and accounts for an estimated 17—44% of pneumonia admissions in young children.[1,2] Routine childhood immunization with conjugate pneumococcal vaccines is associated with a reduction in pneumonia hospitalization in children.[3—6] In Hong Kong, universal conjugate pneumococcal vaccination in children was implemented in 2009. We conducted a study to document the baseline pneumococcal pneumonia hospitalization before the introduction of universal vaccination with conjugate pneumococcal vaccine and to explore the role of common respiratory viruses in children hospitalized for bacterial pneumonia.

In children, the accurate diagnosis of bacterial pneumonia, including pneumonia caused by *S. pneumoniae*, has always been less than certain. A sputum sample is not easily obtained from young children, and the isolation of bacteria from sputum may only reflect colonization. Blood culture has a very low yield because most bacterial pneumonia in children is not bacteremic. Lung aspirate culture is more sensitive and specific, but this procedure is too invasive for routine use in most pediatric practices because of the risk of pneumothorax.[7] To provide an objective endpoint in vaccine trials that evaluate the efficacy of protection against pneumonia, the World Health Organization (WHO) has developed a standardized protocol for diagnosing pneumonia, based on chest radiograph (CXR) findings.[8,9] The finding of alveolar consolidation on CXR by two independent observers is associated with a bacterial cause. The assumption is that *S. pneumoniae* is the major etiology for bacterial pneumonia.

We compared the incidence of hospitalization for bacterial pneumonia as a reflection of pneumococcal pneumonia in Hong Kong children. We used the WHO standardized protocol and the discharge diagnosis by pediatricians to obtain the population-based age-specific incidences as a baseline before the licensing and inclusion of the conjugate pneumococcal vaccines into the universal immunization program in Hong Kong.

Materials and methods

Study design and participants

The Hong Kong Special Administrative Region (SAR) comprises Hong Kong Island, the Kowloon peninsula, the New Territories, and some sparsely populated outlying islands. In 2006, the number of people residing less than 5 years in Hong Kong Island was 37,345 people.[10] The Pamela Youde Nethersole Eastern Hospital (PYNEH) situated at the eastern end and the Queen Mary Hospital (QMH) situated at the south-west, are the only two public hospitals on Hong Kong Island, with a total of 153 pediatric beds. They care for 72.5% of all pediatric admissions on the Island. There are 16 public hospitals with an emergency department for all of Hong Kong SAR and non—Hong Kong Island residents in general do not cross the Harbor to Hong Kong Island for emergency room attendance and admission for an acute general pediatric problem. Census data were used to define the at-risk age-stratified population.

For the purpose of this study, the CXRs of children admitted from 2002 to 2004 were recently retrieved for independent reading by two qualified radiologists who used the WHO protocol. Medical records of these children were also retrieved for review. This period was chosen because this was the closest period before the availability of conjugate pneumococcal vaccine in Hong Kong. All children younger than 5 years old who were admitted with an acute febrile respiratory illness during one 24-hour period each week to PYNEH (Tuesday) and QMH (Wednesday) from September 2002 to August 2004 were specifically included. Children with an underlying condition and a history consistent with apparent aspiration pneumonia were excluded. The CXRs were ordered in the emergency department at the discretion of the emergency department (ED) physicians or ordered after admission by the attending pediatrician if a CXR had not been performed and the child's condition was considered to warrant a CXR.

Definition of pneumonia by CXR (i.e., endpoint consolidation)

The CXRs of the patients for an admission were retrieved and read independently by two radiologists who followed the WHO definition and were unaware of the clinical diagnoses.[8] Endpoint consolidation is the most specific predictor of bacterial pneumonia and is defined as a "dense opacity that may be a fluffy consolidation of a portion or whole of a lobe or of the entire lung, often containing air bronchograms and sometimes associated with pleural effusion." The radiologists also graded the quality of the films as "uninterpretable", "suboptimal" or "adequate". The data manager monitored the disagreement between the radiologists and those films were pulled for a consensus reading in accordance to the WHO guidelines.

Diagnosis of bacterial pneumonia by pediatricians

For the purpose of this study, the subset of children who were treated by the pediatrician with a full course of beta-