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ORIGINAL ARTICLE

A population-based analysis of children with pneumonia among intensive care units in Taiwan

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Background: Pneumonia is a major diagnosis in children that requires intensive care and is a major cause of mortality in critically ill children. A survey on current epidemiology and case fatality–associated conditions is crucial for the care of critically ill children with pneumonia in an intensive care unit (ICU).
Methods: The sex, age, seasonality of admission, area of distribution, and case fatality rate of children younger than 18 years who had pneumonia and were admitted to an ICU during the period 2006–2010 were obtained from the National Health Insurance Research Database (NHIRD) of Taiwan. The enrolled children were grouped by age (0–2 years, 3–5 years, 6–11 years, and 12–17 years). The need for invasive procedures such as endotracheal tube (ET) insertion, mechanical ventilation (MV), tracheostomy, central venous catheter (CVC) insertion, chest tube insertion/drainage, chest surgery, and extracorporeal membranous oxygenation (ECMO) were analyzed to clarify their association with case fatality in critically ill children with pneumonia.
Results: Of the 12,577 children enrolled, 7131 (56.7%) were boys and 5446 (43.3%) were girls. The younger age groups had more cases of pneumonia, but less often required invasive procedures. Children 0–2 years old (n = 6083) accounted for approximately one-half (48.4%) of all

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enrolled children. This group had the lowest case fatality rate (3.1%; 187/6083 children) and lowest need for invasive procedures (31.1%; 1892/6083 children), whereas children in the 12–17 year-old group had the highest case fatality rate (9.9%; 140/1417 children) and the highest need for invasive procedures (59.8%; 847/1417 children) ($p < 0.001$). The percentage of pneumonia cases was highest in the spring (30.1%) and lowest in the summer (21.7%). The invasive procedures associated with case fatality were ET/MV (OR, 14.31; $p < 0.001$), CVC insertion (OR, 7.46; $p < 0.001$), ECMO intervention (OR, 4.59; $p < 0.001$), and chest tube insertion/drainage (OR, 1.87; $p < 0.001$).

Conclusion: The number of cases of pneumonia that required ICU admission was greater among younger children than among older children. Factors associated with the higher case fatality rate included older age at presentation, the need for invasive procedures (e.g., ET/MV, CVC insertion, chest tube insertion/drainage, and ECMO), underlying comorbidities and complications.

Introduction

Pneumonia is a common infectious disease worldwide that can occur at any age. It causes severe complications and has a poor prognosis, and can result in death. In pediatric patients, it is also a major infectious disease that results in children being diagnosed as critical, which requires intensive care. The incidence of community-acquired pneumonia is reportedly 36–40 episodes per 1000 children per year in children younger than 5 years and 11–16 episodes per 1000 children per year in children 5–14 years.[1] In Europe alone, 2.5 million cases of pneumonia occur annually.[1] The etiology of community-acquired pneumonia has been analyzed in many previous studies to allow adjustments in the administration of antibiotics.[1–7] *Streptococcus pneumonia* is the leading bacterial etiology of pediatric pneumonia, particularly among children younger than 5 years.[4,8] This bacterial species accounts for an estimated 17–44% of pediatric pneumonia admissions.[7,9]

Since 2000, a pneumococcal conjugated vaccine has been used nationwide in the United States to prevent invasive pneumococcal diseases; this has led to a 39% decline in the admission rate of children younger than 2 years old with all-cause pneumonia.[9] There are nevertheless many other pathogens that can cause pneumonia or similar severe infections.[10] Hospital-acquired pneumonia is also a major subset of pediatric pneumonia because it causes severe complications that require invasive procedures as interventions. A previously published report also demonstrates that the implementation of routine vaccination with the conjugated pneumococcal vaccine resulted in an 84% reduction of *Streptococcus pneumoniae* bacteremia and 67% reduction in overall bacteremia in United States.[10] Previous studies in 1997–2004 in Taiwan have shown higher incidences and case fatality rates in hospitalized children with pneumonia who were younger than 5 years old.[11,12] A heptavalent pneumococcal conjugated vaccine was introduced in Taiwan in 2005. The age distribution, disease severity, and the case fatality rate after the introduction of the vaccine may differ from these factors prior to the use of pneumococcal conjugated vaccine in critically ill children with pneumonia who were admitted to an intensive care unit (ICU). Thus, a detailed investigation of the post-pneumococcal vaccination period in critically ill children is crucial in Taiwan.

A previous investigation in Taiwan indicated that approximately 20% of hospitalized children diagnosed with pneumonia require ICU admission. Despite this intervention, some children still have a poor outcome, especially children with pneumococcal pneumonia.[13] Based on disease severity and complications that are present, these children may need invasive procedures for therapeutic purposes. In such circumstances, a detailed survey on current epidemiology and related factors associated with case fatality may help guide clinicians in the care of critically ill children with pneumonia.

The purpose of this study was to investigate the epidemiology and case fatality-associated conditions in critically ill children with pneumonia who are admitted to an ICU. This study was conducted by using 5 years (2006–2010) of data from the nationwide National Health Insurance Research Database (NHIRD) of Taiwan.

Methods

Data sources

In 1995, a universal compulsory national health insurance was introduced in Taiwan; in 2011, it provided coverage for 99.6% of the population living in Taiwan.[14] The National Health Research Institute (NHI) of Taiwan maintains a large computerized administrative database from the National Health Insurance program that includes data on complete outpatient visits, hospital admissions, prescriptions, disease, and vital status for this population. Therefore, the National Health Insurance Research Database (NHIRD) of Taiwan is one of the largest and most comprehensive nationwide population-based databases available in the world.

All information from the NHIRD was double encrypted to exclude any possibility of identifying individual information.[15] The Institutional Review Board of Taipei Veterans General Hospital approved this study (VGHIRB; No. 2012-06-006A).