Pulmonary Infarction in Necrotizing Pneumococcal Pneumonia with Bronchopleural Fistula among Children in Taiwan

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ABSTRACT

Background: Severe necrotizing pneumococcal pneumonia may progress to the development of bronchopleural fistula. The purpose of this study was to describe the clinical courses and identify risk factors of children with the development of bronchopleural fistula in children with pneumococcal pneumonia. Histopathologic features of children receiving surgical resections of the lung because of bronchopleural fistula were analyzed to explore the pathogenesis of destructive lung disease caused by Streptococcus pneumoniae.

Methods: A total of 112 cases of culture-proven pneumococcal pneumonia were identified between January 2001 and March 2010 at Chang Gung Children’s Hospital. The medical charts of all cases of culture-proven pneumococcal pneumonia were reviewed.

Results: Pneumococcal pneumonia in 18 children (18/112, 16.1%) was complicated by bronchopleural fistula. Comparing children without bronchopleural fistula, children with bronchopleural fistula had significantly lower WBC counts at admission (P = 0.03) and significantly longer durations of fever and hospitalization (P = 0.002). Multivariate analysis revealed that acute respiratory failure (OR = 4.9, 95% CI = 2.6-9.9; P = 0.001) and serotype 19A infection (OR = 5.0, 95% CI = 1.22-22.2; P = 0.03) were risk factors for the development of bronchopleural fistula. Histopathologic analyses were available for twelve children who underwent pneumonectomy and for ten children who underwent thoracotomy and surgical resection of the involved lung.

Conclusions: By causing tissue ischemia, S. pneumoniae damaged lung tissue more severely and extensively. Pneumococcal conjugal vaccine should cover serotype 19A to prevent children in Taiwan from this serious complication.

MATERIALS AND METHODS

Bacterial isolates, Antimicrobial Susceptibility Testing, and Serotyping
Minimal inhibitory concentrations (MICs) of penicillin and ceftriaxone were determined using the Etest (AB Biodisk). Criteria to define susceptibility or resistance were based on the Clinical and Laboratory Standards Institute (CLSI) guidelines for pneumonia. The isolates’ serotypes were determined using the capsular swelling method (Quellung reaction). All antigens were obtained from the Statens Serum Institute (Copenhagen, Denmark).

Analysis by Pulse-Field Gel Electrophoresis (PFGE) and Multi-Locus Sequencing Type (MLST)
Pulsed-field gel electrophoresis was performed with methodology described elsewhere. DNA was digested with Smal. Bands were stained with ethidium bromide and visualized with UV light. PFGE patterns that differed by ≥ 2 bands were defined as a single PFGE type. At least 1 isolate within each PFGE type was chosen for MLST, which was performed as previously described. Clinical complexes (CC) primarily comprised sequence types that shared 6 of 7 alleles with at least 2 other sequence type in the complex.

Histopathologic analysis
The necrotized lung tissue was fixed in 4% formaldehyde, embedded in paraffin, and cut in 4-μm-thick sections for staining with hematoxylin and eosin (H&E). One pulmonary pathologist examined all the lung samples.

RESULTS

This study found serotype 19A CC320 was strongly associated with necrotizing pneumococcal pneumonia and the development of bronchopleural fistula. Pulmonary infarction was a histopathologic feature of most children with necrotizing pneumococcal pneumonia complicated by BP.

In cases of pneumonia complicated by BP, the clinical presentation may be characterized by fever, wasting, malaise, or dyspnea. Sawicki et al. reported that the cases of all children with BP were managed conservatively without surgery. Whereas Haschmalbusch et al. reported that 80% of children with BP required surgical resection of the lung, which was closer to the surgical rate in children with BP in our study. 91.7% (11/12) of the children who underwent surgical resections of the lung had pathologic findings of pulmonary infarction. The major limitation in this study is that it was a retrospective analysis. We might have missed children without obvious signs of air leak in the pleura, which may have introduced a selection bias. For the first time, we undertook surgical resections of lung. Cooperative necrosis with pulmonary infarction was found in 93.7% (11/12) of cases.

In terms of the clinical features, the cases of 112 cases of culture-proven pneumococcal pneumonia were identified between January 2001 and March 2010 at Chang Gung Children’s Hospital. The medical charts of all cases of culture-proven pneumococcal pneumonia were reviewed.

DISCUSSION

This study found serotype 19A CC320 was strongly associated with necrotizing pneumococcal pneumonia and the development of bronchopleural fistula. Pulmonary infarction was a histopathologic feature of most children with necrotizing pneumococcal pneumonia complicated by BP.