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# Pleural antigen assay in the diagnosis of pediatric pneumococcal empyema

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**Keywords:**
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**Abstract**

**Purpose:** The purpose of the study was to assess the diagnostic value of rapid pneumococcal antigen detection (PAD) in pleural fluid samples of children with empyema.

**Material and Methods:** We performed a prospective evaluation in a pediatric intensive care unit of a tertiary university hospital of children aged 1 month to 14 years admitted with empyema. Standard cultures (conventional microbiological culture [CMC]), PAD by immunochromatographic testing (Binax NOW *Streptococcus pneumoniae*; Binax, Portland, ME), and/or real-time polymerase chain reactions (RTPs) on pleural samples were performed in all included patients.

**Results:** Fifty-five cases with a mean (SD) age of 6.5 (6.1) years were enrolled. *Streptococcus pneumoniae* was identified in 28 cases (51%): by CMC in 15 cases and by RTP in a further 13 cases. Using CMC and/or RTP as the criterion standard, PAD showed a sensitivity of 96% (95% confidence interval, 86%-100%), a specificity of 100% (75%-100%), a positive predictive value of 100% (98%-100%), and a Youden index of 0.96 (0.88-1.04).

**Conclusions:** Pneumococcal antigen detection in pleural fluid specimens from children provides a rapid, simple, sensitive, and reliable method of diagnosis for pneumococcal empyema at bedside.



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## 1. Introduction

Pediatric parapneumonic effusion incidence—and particularly that of pneumococcal origin—has increased worldwide in recent years without definitive explanation [1-3]. Conventional microbiological cultures (CMCs) in blood and/or pleural samples for pediatric empyema frequently have false-negative results [3]. Newer techniques such as real-time polymerase chain reaction (RTP) and rapid pneumococcal antigen detection (PAD) are reliable tools with important differences in availability, costs, and method difficulty [4-8]. However, their diagnostic value has not been clearly established for pleural fluid samples [9,10]. The aim of this study was to prospectively evaluate the diagnostic value of PAD in pneumococcal empyema in children.

## 2. Material and methods

We developed a prospective study in the pediatric critical care unit of a tertiary university hospital. All children admitted to our pediatric intensive care unit (PICU) from January 2006 to July 2009 with pediatric parapneumonic effusion requiring diagnostic and/or therapeutic thoracocentesis were included. In all cases where etiological identification by conventional microbiological cultures in blood and/or pleural samples failed, pleural samples stored during acute phase were further assessed using RTP assays and/or PAD by immunochromatographic testing. The performance of one or both techniques relied on the availability and amount of stored sample, giving default priority to PAD. Real-time polymerase chain reaction was performed (1) to detect pneumococcal DNA (ply and wzg genes) and (2) to identify the pneumococcal serotypes with novel RTP assays [4,5]. The method used highly specific TaqMan MGB probes that targeted DNA sequences within the capsular polysaccharide gene cluster of 24 different serotypes. These DNA sequences were amplified by 10 different polymerase chain reactions corresponding to ugd (for serotypes 1 and 5), wchE (for serotype 3), wciJ (for serotype 4), wciP (for serotypes 6A and 6B), wcwA (for serotypes 7F/A), wzy (for serotypes 14 and 15B/C), wchO (for serotypes 19A and 19F/B/C), gct (for serotypes 18C/B), and wchV (for serotypes 23F and 23A) genes (different genes within the capsular locus). Pneumococcal antigen detection by immunochromatographic testing (Binax NOW *Streptococcus pneumoniae* Antigen test; Binax, Portland, ME) was also performed in pleural sample following manufacturer's instructions in all included patients with negative CMC. The results of this test were compared with the identification of *S pneumoniae* by pleural fluid RTP and/or conventional culture of pleural fluid or blood. This study was approved by the ethics committee of Galicia (www.sergas.es). Informed parental consent was obtained for each patient.

Sensitivity (S), specificity (E), likelihood ratios, and Youden's index (S + E − 1) [11] were calculated using the combination of CMC and/or RTP results as the test criterion standard. SPSS version 17.0 (SPSS Inc, Chicago, IL) and EPIDAT (version 3.1, 2006; Dirección Xeral de Saude Pública, Organización Panamericana de la Salud) were used for statistical analysis.

## 3. Results

During the study period, 55 children with a mean (SD) age of 6.5 (6.1) years were enrolled. Pneumococcus was identified in 28 (50.9%) of 55 cases: by CMC in 15 cases and by RTP in a further 13 cases (13 [81.2%] of 16 negative CMC samples analyzed). Among those in which serotype

**Table 1** Summary of microbiological characteristics of the 55 included children

| | Total no. positive/ no. of samples analyzed (%) | CMC no. positive/ no. of samples analyzed (%) | RTP in negative CMC no. positive/ no. of samples analyzed (%) | PAD in negative CMC no. positive/ no. of samples analyzed (%) |
|---|---|---|---|---|
| ***S pneumoniae*** | **28/55 (50.9%)** | **15/55 (27.3%)** | **13/16 (81.2%)** | **24/27 (88.9%)** |
| ***S 1*** | 10 (42%) | 5 | 5 | 9 |
| ***S 19A*** | 3 | 2 | 1 | 3 |
| ***S 7F*** | 3 | 2 | 1 | 3 |
| ***S 3*** | 2 | 1 | 1 | 2 |
| ***S 6B*** | 2 | 1 | 1 | 2 |
| ***S 9V*** | 2 | 1 | 1 | 1 |
| ***S 14*** | 1 | 1 | - | 1 |
| ***S 23F*** | 1 | - | 1 | 1 |
| Unknown serotype | 4 (14%) | 2 (13%) | 2 (15%) | 2 |
| **Other etiologies** | **8/55 (14%)** | | | |
| ***S pyogenes*** | 2 | | | |
| **Other** | 6 | | | |
| **Negative** | **19/55 (34%)** | | | |