Sero-epidemiology of Pneumococcal Pneumonia and Invasive Pneumococcal Disease in Adults, Ontario, Canada, 2000-2010

W. RUDNICK, K. GREEN, S. PONG-PORTER, A. PLEVNESHI, D. LOW, A. MCGEER,
Toronto Invasive Bacterial Diseases Network; Mount Sinai Hospital, Toronto, Canada

Abstract

OBJECTIVES: To assess the changing sero-epidemiology of pneumococcal disease in adults.

METHODS: TBIDN has conducted population-based surveillance for invasive pneumococcal disease (IPD) and lab-confirmed non-bacteraemic pneumococcal pneumonia (NBPP) since 2002. Serotyping and broth microdilution susceptibility testing to CLSI standards is performed. PCV7 was licensed in 2001. Publicly-funded infant PCV7 began in 2005.

RESULTS: From 2002 to 2010, 3894 cases of adult IPD/NBPP were identified. In adults ≥65y, the IPD rate decreased from 34.3 to 26.5/100000/y (2002-2010). The IPD rate due to serotypes (STs) included in PCV7 decreased from 19.1 to 3.3/100000/y, that due to PCV13/STs PCV7 increased from 5.3 to 11.5/100000/y, and that due to non-conjugate vaccine (NPCV) serotypes increased from 9.9 to 11.7/100000/y. The rate of IPD for adults 15-64y was 5.3 and 4.8/100000/y in 2002 and 2010. The rate of IPD due to PCV7 serotypes decreased from 3.1 to 0.9/100000/y, that due to PCV13/nonPCV7 serotypes increased from 1.0 to 2.2/100000/y, and that due to NPCV serotypes increased from 1.2 to 2.0/100000/y. Changes in serotype distribution are greater than changes in incidence (see Table 1 below).

Table 2: Sero-type distribution of isolates covered by PCV13 in adult IPD and NBPP cases and other respiratory-site isolates (2002, 2006 and 2010).

<table>
<thead>
<tr>
<th>Sero-type</th>
<th>PCV13 in IPD</th>
<th>PCV13 in NBPP</th>
<th>Other respiratory-site isolates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serotype 8</td>
<td>56.7%</td>
<td>34.4%</td>
<td>10.1%</td>
</tr>
<tr>
<td>Serotype 3</td>
<td>34.4%</td>
<td>30.4%</td>
<td>6.1%</td>
</tr>
<tr>
<td>Serotype 7</td>
<td>15.6%</td>
<td>15.5%</td>
<td>6.1%</td>
</tr>
<tr>
<td>Non-conjugate serotype</td>
<td>0.0%</td>
<td>2.4%</td>
<td>8.0%</td>
</tr>
</tbody>
</table>

Serotypes in PCV10 but not PCV7 are more common in IPD than NBPP and were rare until 2008, when serotype 7F emerged. Among NPCV serotypes, disease due to serotypes 12F, 22F, and 31 has been decreasing, and disease due to serotypes 11A, 23A, 33A, and 8 has been increasing. PCV7 serotype isolates were more resistant (R) to penicillin, oxacillin, erythromycin, and levofloxacin; however, increasing resistance overall means combined resistance to erythromycin has increased, resistance to penicillin/oxacillin is stable. Resistance to levofloxacin has decreased.

CONCLUSIONS:

Infant PCV7 has dramatically reduced the incidence of adult IPD and NBPP due to PCV7 serotypes; however, overall disease rates have decreased only 25%. PCV13/nonPCV7 strains now comprise nearly 50% of adult IPD and NBPP.

Methods

From 1995 to 2010, prospective, population-based surveillance for invasive pneumococcal disease (defined as illness associated with a sterile site isolate of S. pneumoniae) was conducted in metropolitan Toronto and Peel region. From 2002 to 2010, all respiratory site isolates from hospital laboratories were also collected.

Serotype is determined using latex pneumococcal antiserum (Statens Serum Institut, DK) and the Quellung reaction. Antimicrobial susceptibility testing is performed by broth microdilution to CLSI standards. Population data are obtained from Statistics Canada. Demographic and clinical data are collected from review of health records and interviews with patients and attending physicians.

Nonbacteraemic pneumococcal pneumonia (NBPP) was defined using a modified version of the Musher criteria (Medicine 79:20-21, 2000). Clinical presentation suggested of pneumonia, infiltrate on chest radiograph; microscopic examination of a Gram-stained sputum with white cells and predominance of Gram-positive cocci, culture of sputum yielding S. pneumoniae and no other likely bacterial pathogens; and blood cultures either negative or not done.

Results

From 2000 to 2010, 3894 cases of adult (≥15y) IPD and 508 cases of non-bacteraemic pneumococcal pneumonia (NBPP) were identified. There were 3590 other isolates of pneumococci identified from respiratory specimens. Older adults (≥65y) comprised 47% of cases.

From 2000 to 2010, 47 NPCV serotypes were represented in IPD isolates. Only serotypes 8, 22F and 9C represented <5% of any year’s IPD isolates. Serotype 6C was differentiated from 6A starting in July 2010 and represented 6.6% of isolates in 2010.

Among NPCV strains, adult IPD due to serotypes 12F, 22F, and 31 has been decreasing, and disease due to serotypes 11A, 23A, 33A, 15A, and 8 has been increasing.

From 2000 to 2010, all respiratory site isolates from hospital laboratories were also collected.

Infant PCV7 has reduced the incidence of adult IPD and NBPP due to PCV7 serotypes 10 fold; however, overall disease incidence has decreased by only 25%.

Erythromycin resistance has increased steadily in all serotypes, although serotype 19A has been over represented (27% of ery R isolates in 2010).

Conclusions

Infant PCV7 has reduced the incidence of adult IPD and NBPP due to PCV7 serotypes 10 fold; however, overall disease incidence has decreased by only 25%.

Among adults, serotype 19F is more common among respiratory than IPD isolates, 15A is more common in NBPP and IPD than in other respiratory isolates, serotype 15 is associated with IPD, and serotype 7F is associated with IPD.

The evolution of antibiotic resistance is different in different serotypes. Serotype 19A was over represented among respiratory isolates (29% of pan R and 27% of ery R isolates in 2010). Almost all pan R is due to PCV13 strains; however, ery R is emerging among NPCV strains.

Acknowledgements

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