Abstract

Streptococcus pneumoniae is an important human pathogen associated with respiratory tract infections and invasive diseases such as bacteremia and meningitis. It mostly affects young children, particularly those under the age of two, and older adults. Infections by this pathogen are fatal, unless treated in a timely manner. The widespread use of antibiotics has led to reduced efficacy due to the development of antibiotic-resistant strains, mainly due to the overuse and misuse of antibiotics, which has become an unacceptable consequence. Beta-lactam and macrolide antibiotics are among the recommended treatment options for S. pneumoniae infections. Antibiotic resistance in S. pneumoniae is widespread, affecting treatment options and outcomes. In Canada, macrolide resistance occurs when either the erythromycin target site is modified by erm(1) genes or efflux pump of macrolides. In light of increasing resistance and limited new drug options, the use of vaccines to prevent pneumococcal infections and to reduce antibiotic resistance become absolutely necessary. To date, 91 serotypes of S. pneumoniae have been identified. Of these, 23 of them are included in a polysaccharide-based vaccine, PCV23, recommended for adults and at-risk children. Before the introduction of the pneumococcal vaccine for children aged 2, seven serotypes (4, 6B, 14, 18C, 19F, 20, 23F) and one non-vaccine serotype (3) were the most commonly isolated strains. Since the introduction of the vaccine, S. pneumoniae sepsis decreased, particularly among children. However, we have recently observed a significant increase in the incidence of invasive pneumococcal disease due to non-vaccine serotypes, particularly serotypes 1, 3, 5, 7, and 19A. This has been shown to have been driven by non-vaccine serotypes, particularly serotypes 1, 3, 5, and 19A. In the present study, we examined the evolution of serotypes and assessed PCV7 vaccine coverage among macrolide-resistant S. pneumoniae isolates in Canada in the last 10 years.

Materials and Methods

Serotyping: Serotyping was performed by capsular swelling (Quellung reaction) in antisera from the Statens Serum Institut (Copenhagen, Denmark) according to the manufacturer’s instructions on 1461 of the 12,759 macrolide-resistant S. pneumoniae isolates. The isolates were collected as part of the Canadian Respiratory Organism Susceptibility Study (CROSS) and between 2007 and 2008 as part of the Canadian Ward (CANWARD) study. Both studies were conducted at the central laboratory (Health Sciences Centre, Winnipeg, Manitoba, Canada). Streptococcus pneumoniae isolates were serotyped by capsular swelling (Quellung reaction) at the central laboratory. Isolates were grouped into PCV7-serotypes, PCV7-related serotypes and non-PCV7 serotypes. In total, 1031 PCV7 serotypes ranged from 18% (2007) to 74% (2001) and overall decreased 36%, from 67% to 31% between 1998 and 2008. PCV7-related serotypes ranged from 0% (1998) to 17% (2001) and increased in ten years. Non-PCV7 serotypes ranged from 20% (1999) to 65% (2007), an overall increase of 24%. Conclusion: The results of this study show that vaccination with PCV7 has been successful in reducing the incidence of invasive pneumococcal disease caused by the serotypes covered by the vaccine. However, there is a need to develop new vaccines suitable for use in children in this age group. PCV7 has been shown to be very successful in reducing the incidence of invasive pneumococcal disease caused by the vaccine serotypes covered by the vaccine and at decreasing the prevalence of vaccine type-resistant S. pneumoniae serotypes. Ongoing surveillance is essential to monitor the evolution of pneumococcal serotypes and to ensure effective use of vaccine resources.

Conclusions

An average decrease of 3.2% was observed for PCV7 serotypes while an average increase of 3.2% was observed for the non-PCV7 serotypes. Serotype 19A increased from 0% to 29% between 1998 and 2008. Serogroup 15 increased from 12% to 23% between 1998 and 2008. Serotype 11A, 12 and serogroups 33 and 35 are the other emerging serotypes in Canada.