23-valent pneumococcal vaccine failure in a patient who developed pneumonia: a case report

Silvio Tafuri[1], Domenico Martinelli[2], Anna Grimaldi[3], Annunziata Lopatriello[3], Vincenza Giorgio[4], Rosa Prato[2]

[1]Department of Biomedical Sciences, Hygiene Section, University of Bari Aldo Moro, Bari, Italy;
[2]Department of Medical Sciences, Hygiene Section, University of Foggia, Foggia, Italy;
[3]Microbiology Unit, Triggiano Hospital, Bari Local Health Unit, Triggiano, Bari, Italy;
[4]Respiratory Disease Unit, Triggiano Hospital, Bari Local Health Unit, Triggiano, Bari, Italy

SUMMARY

We report a clinical failure of a pneumococcal vaccine in a patient who developed pneumococcal pneumonia. In 2008, an 85-year-old Italian woman was admitted to the Respiratory Disease Unit of a hospital in Southern Italy. The 23-valent pneumococcal vaccine had been administered to the patient 50 days earlier. The chest x-ray disclosed a right basal bronchopneumonic focus. *Streptococcus Pneumoniae* serotype 19A, a strain included in the 23-valent pneumococcal vaccine, was isolated from the sputum. There is a need for more efficacious conjugated vaccines covering the majority of the pneumococcal serotypes that cause serious illness in older children and adults worldwide.

KEY WORDS: 23 valent pneumococcal vaccine, *Streptococcus Pneumoniae* serotype 19A, Vaccine failure

Received March 03, 2011 *Accepted* July 13, 2011

INTRODUCTION

Streptococcus pneumoniae is a major cause of morbidity and mortality in infants, children and elderly adults.

Despite the availability of excellent antimicrobial therapies and high-quality health care systems, respiratory diseases and invasive infections caused by pneumococci are still a major health problem (Bogaert D. *et al.,* 2004).

Pneumococcal polysaccharide vaccines (PPVs) were developed more than 50 years ago and have progressed from 2-valent vaccines to the current 23-valent vaccine, which has been available since the early 1980s. The 23-valent vaccine includes serotypes that are responsible for 72-95% (Kyaw M.H. *et al.,* 2000) of invasive pneumococcal disease, depending on which geographic areas are considered.

In many industrialised countries, including Italy, pneumococcal vaccination is currently recommended for individuals aged 65 years and older and for individuals aged 2-64 who are at increased risk of pneumococcal disease (Center for Disease Control, 2006; Noakes K. *et al.,* 2006). A 7-valent Pneumococcal Conjugate Vaccine (PCV7) has shown high efficacy against invasive pneumococcal diseases caused by vaccine serotypes in children under 5 years old. Recently, both 10- and 13-valent PCV have been licensed in Europe. Although most authorities agree that PPV is protective at some level, conflicting results have been obtained and controversy continues to surround the issue (Huss A. *et al.,* 2009).

We report a clinical failure of a pneumococcal vaccine in a patient who developed pneumococcal pneumonia. Regulatory authorities consider vaccine failure to be an adverse event following immunisation. This report may contribute to the discussion of PPV immunisation strategies in the elderly.

Corresponding author
Prof. Rosa Prato
Department of Medical Sciences
Hygiene Section
University of Foggia
Ospedali Riuniti di Foggia
Viale L. Pinto - 71100 Foggia
E-mail: r.prato@unifg.it

CASE REPORT

In 2008, an 85-year-old Italian woman was admitted with pneumonia to the Respiratory Disease Unit of a hospital in Southern Italy. On admission, examination revealed a fever of >38°C, groaning on expiration and extensive rhonchi, wheezing with small bubbles in the right medial basal segment and fine crackling in the right basal lobe, which was dull to percussion. The patient's medical history revealed that she was suffering from arterial hypertension and chronic asthmatic pulmonary disease with periodic exacerbations (1-2 times a year), and also that both the 23-valent pneumococcal vaccine and the influenza vaccine had been administered to the patient 50 days earlier.

The patient reported that, 23 days before hospital admission, she had had dyspnea, a high temperature, a congested cough, mucopurulent sputum and right thoracic pain. Her general practitioner had prescribed treatment with a bronchodilator and antipyretic, antibiotic and cortisone therapy. A chest x-ray performed 13 days before hospital admission had not shown any focal parenchymal lesions. The pharmacological therapy had resulted in some limited improvement, including attenuation of dyspnea and a normal stable temperature. However, respiratory problems and a high temperature returned, and the patient's doctor recommended admission to hospital.

On admission, blood chemistry tests showed the following: a white cell count of 20.170 x ml, neutrophil leukocytosis: 92%, lymphopaenia: 14.7%, monocytes: 3.3%, PLT: 284.000/mm^3, sedimentation rate: 33 mm/h (NR: 1-15 mm/h), Uricemia: 6.9 mg%; PCR: 275.2 mg/dl. Other blood-chemistry tests did not show pathological values, and the tests for HIV and *Legionella Pneumophila* urine antigen were negative.

The chest x-ray performed on admission disclosed a right basal bronchopneumonic focus with signs of consensual pleurisy. Chemico-physical analysis of the pleural liquid showed the following: pleural fluid/serum LDH ratio: 0.52; pleural fluid/serum protein ratio: 0.94; amylases: 24 mg/dl; glucose: 152 mg/dl; pH=7.54; neutrophils: 45%; lymphocytes: 55%.

A phlegm sample was placed on plates containing MacConkey agar, Sabouraud-chloram-phenicol agar, Columbia sheep blood agar, Columbia CNA agar, Chocolate agar with bacitracin and Mannitol. Plates were incubated for 24 h under aerobiosis at 37°C, except for the chocolate medium plates, which were incubated in a microaerophile environment at 5% carbon dioxide. *Streptococcus pneumoniae* was isolated.

The biochemical identification of the strain and the antibiogram were carried out with the PHOENIX (BD) panel system, and the MIC was determined following the guidelines of the Clinical and Laboratory Standard Institute. The rapid assay, Now (PROMESAN), for the detection of *Streptococcus pneumoniae* antigen in urine, was positive. *Streptococcus pneumoniae* serotyping, performed according to the techniques described by Azzari *et al.* (Azzari C. *et al,* 2008), revealed *Streptococcus pneumoniae* 19A, a strain included in the 23-valent pneumococcal vaccine.

Having taken into account the antibiogram results, the patient received antibiotic therapy with Cefotaxime (1 g x 2) and Moxifloxacin (400 mg/day), and was discharged after 15 days.

DISCUSSION

Our report describes a case of pneumococcal pneumonia in a non-immunocompromised patient who received a pneumococcal vaccine less than one month before the onset of symptoms. This cannot be thought of as a breakthrough infection as vaccine-breakthrough pneumococcal infection was considered that in hematopoietic stem cell transplantation recipients who had infection 4 weeks after receiving pneumococcal vaccination (Debbache K. *et al.,* 2009; Kumar D. *et al.,* 2008; Youssef S. *et al.,* 2007).

When considering the 23-valent pneumococcal vaccine as 23 different vaccines rather than one, there is evidence that some individuals could fail to respond to some serotypes (Örtqvist Å. *et al.,* 2007). Factors complicating the definition of the normal antibody response to polysaccharide antigens are its variation with age, the differing prevalence of serotypes in different populations, and variation in the immunogenicity of individual serotypes.

Individuals with otherwise normal immune function tests may have a poor or non-existent anti-

body response to such antigens, described as Selective Anti-polysaccharice Antibody Deficiency (Akikusa J.D. *et al.,* 2001).
A variety of methods have been used to estimate the protective effect of PPV, including prospective clinical trials, case control studies, cohort studies, and comparisons of infecting serotypes in vaccinated and non-vaccinated subjects. Meta-analyses of controlled clinical trials have produced conflicting results regarding the efficacy of PPV. The lack of consistency between the results reported from observational studies and those from controlled trials is another reason why the efficacy of the vaccine remains controversial (Huss A *et al.,* 2009).
PPV has been widely introduced into vaccination programs for elderly people and high-risk populations in industrialised countries. In many cases, the decision to implement vaccination programs was based on a possible protective effect of the pneumococcal polysaccharide vaccine on invasive pneumococcal disease, which has been seen in observational studies but not clearly documented in high-quality clinical trials.
Of all the possible strategies for preventing pneumococcal pneumonia, only vaccination has been subjected to economic evaluation. PPV seems relatively cost-effective (and potentially cost-saving) for those between 65 and 75 years of age, military recruits and HIV-positive patients with a sufficiently high CD4 T cell count. Based on economic evaluations, authorities in some high-income and middle-income countries recommend that PPV23 should be given to target populations demonstrated to be at increased risk of morbidity and mortality from pneumococcal infection, including individuals with sickle-cell disease or those lacking a functional spleen, individuals with underlying diseases affecting the cardiopulmonary system and individuals with immunosuppressive conditions, including HIV infection (WHO, 2008).
The prevention of the large burden of disease associated with pneumococcal pneumonia should be a major objective from a public health perspective. As supported by the WHO, there is a need for more efficacious conjugated vaccines or other types of vaccines covering the majority of the pneumococcal serotypes that cause serious disease in older children and adults worldwide and that are frequently also responsible for resistance to commonly used antimicrobial drugs (WHO, 2008).
A more reliable assessment of vaccine effectiveness may be through improved molecular epidemiologic surveillance. In Italy, information regarding the true incidence of invasive bacterial diseases is limited because monitoring is carried out only on meningitis, for which a national system has been in place since 1994. For the meningococcus forms, this has been extended to sepsis. It merits consideration that the estimates for the incidence of invasive bacterial diseases can be strongly influenced by the failure to apply diagnostic tests.

CONCLUSIONS

An improvement in surveillance is necessary to monitor the change in *S. pneumioniae* serotypes in circulation following the implementation of heptavalent conjugate pneumococcal vaccine in children and 23-valent pneumococcal polysaccharide vaccine in adults over 65 and/or at high risk of infection. Better surveillance can contribute to a critical revision of the indicators for vaccination with the 23-valent pneumococcal vaccine and other vaccinations for invasive bacterial diseases.
Strong herd immunity was observed in many countries after PCV7 introduction, with a subsequent decrease of PCV7 strains in the adult and elderly population as well. Similarly, in the United States, there has been a substantial reduction in the proportion of cases caused by the serotypes in the PCV7, but an increase in cases caused by non-vaccine serotypes has also been noted (Farrell D.J. *et al.,* 2007). Our report documents a case of pneumococcal pneumonia resulting from the 19A strain, which is included in PPV23 but not in PCV7. This strain is included among those that have a higher risk of increased incidence after the introduction of PCV7 vaccination in children. Including the 19A strain in a new multi-valent conjugate vaccine could have the same beneficial effect.

ACKNOWLEDGEMENTS
We are very grateful to Prof. Chiara Azzari, MD (Mayer Hospital, Florence), who performed Streptococcus pneumoniae serotyping and to Dr.

Antonella Carmela Mastria, BD (Microbiology Unit, Triggiano Hospital, Bari), Dr Piero Vinciguerra, MD, Dr. Pia Barbanente, MD, and Dr. Manuela Rollo, MD (Respiratory Disease Unit, Triggiano Hospital, Bari) for their technical assistance.

REFERENCES

Akikusa J.D., Kemp A.S. (2001). Clinical correlates of response to pneumococcal immunization. *J. Paediatr. Child Health.* **4**, 382-387.

Azzari C., Moriondo M., Indolfi G., Massai C., Becciolini L., de Martino M., Resti M. (2008). Molecular detection methods and serotyping performed directly on clinical samples improve diagnostic sensitivity and reveal increased incidence of invasive disease by Streptococcus pneumoniae in Italian children. *J. Med. Microbiol.* **57** (Pt 10), 1205-1212.

Bogaert D., Hermans P.W., Adrian P.V., Rumke H.C. de Groot R. (2004). Pneumococcal vaccines: an update on current strategies. *Vaccine*. **22** (17-18), 2209-2220.

Center for Disease Control. (2006). Recommended Adult Immunization Schedule - United States, October 2006 - September 2007. MMWR Morb Mortal Wkly Rep; 55: Q1-4.

Debbache K., Varon E., Hicheri Y., Legrand P., Donay J.L., Ribaud P., Cordonnier C. (2009). The epidemiology of invasive Streptococcus pneumoniae infections in onco-haematology and haematopoietic stem cell transplant patients in France. Are the serotypes covered by the available anti-pneumococcal vaccines? *Clin. Microbiol. Infect.* **15**, 865-868. Epub 2009 Jun 22.

Farrell D.J., Klugman K.P., Pichichero M. (2007). Increased antimicrobial resistance among nonvaccine serotypes of streptococcus pneumoniae in the pediatric population after the introduction of 7-valent pneumococcal vaccine in the United States. *Pediatr. Infect. Dis. J.* **26**, 123-128.

Huss A., Scott P., Stuck A.E., Trotter C., Egger M. (2009). Efficacy of pneumococcal vaccination in adults: a meta-analysis. *CMAJ.* **180**, 48-58.

Kumar D., Humar A., Plevneshi A., Siegal D., Franke N., Green K., McGeer A., Toronto Invasive Bacterial Diseases Network. (2008). Invasive pneumococcal disease in adult hematopoietic stem cell transplant recipients: a decade of prospective population-based surveillance. *Bone. Marrow. Transplant*. **41**, 743-747. Epub Jan 7.

Kyaw M.H., Clarke S., Edwards G.F., Jones I.G., Campbell H. (2000). Serotypes/groups distribution and antimicrobial resistance of invasive pneumococcal isolates: implications for vaccine strategies. *Epidemiol. Infect.* **125**, 561-572.

Noakes K., Pebody R.G., Gungabissoon U., Stowe J., Miller E. (2006). Pneumococcal polysaccharide vaccine uptake in England, 1989–2003, prior to the introduction of a vaccination programme for older adults. *J. Public. Health.* (Oxf) **28**, 242-247.

Örtqvist Å., Henckaerts I., Hedlund J., Poolman J. (2007). Non-response to specific serotypes likely cause for failure to 23-valent pneumococcal polysaccharide vaccine in the elderly. *Vaccine.* **25**, 2445-50. Epub 2006 Sep 20.

WHO (2008). 23-valent pneumococcal polysaccharide vaccine. WHO position paper. *Wkly. Epidemiol. Rec.* **83**, 373-384.

Youssef S., Rodriguez G., Rolston K.V., Champlin R.E., Raad I.I. Safdar A. (2007). Streptococcus pneumoniae infections in 47 hematopoietic stem cell transplantation recipients: clinical characteristics of infections and vaccine-breakthrough infections, 1989-2005. *Medicine* (Baltimore). **86**, 69-77.