



Enfermedades Infecciosas y Microbiología Clínica

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Original

Pertussis epidemic despite high levels of vaccination coverage with acellular pertussis vaccine



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ARTICLE INFO

Article history:

Received 7 May 2013

Accepted 5 September 2013

Available online 9 November 2013

Keywords:

Pertussis

Vaccine

Epidemiology

Bordetella pertussis

Surveillance

ABSTRACT

Introduction: We describe the pertussis epidemic, based only on confirmed whooping cough cases. We have analyzed data on the diagnosis, epidemiology and vaccine history in order to understand the factors that might explain the trends of the disease.

Methods: A descriptive study of the confirmed pertussis cases reported during 2011 in the Vallès region (population 1,283,000). Laboratory criteria for confirmed pertussis cases include isolation of *Bordetella pertussis* from a clinical specimen or detection of *B. pertussis* by PCR in nasopharyngeal swabs.

Results: A total of 421 pertussis confirmed cases were reported, which was the highest incidence reported in the last decade (33 cases/100,000 people/year in 2011). The highest incidence rate was among infants less than 1 year old (448/100,000), followed by children 5–9 years old (154/100,000). Pertussis cases aged 2 months–1 year were 90% vaccinated following the current DTaP schedule for their age group in Catalonia, and cases of 5–9 years were 87% fully vaccinated with 5 doses of DTaP vaccine. There were no deaths, although 8% of cases were hospitalized. Pertussis was more severe in infants, 30% required hospitalization despite having received the vaccine doses corresponding to their age. Children of 5–9 years were most often identified as primary cases in households or school clusters.

Conclusion: Despite high levels of vaccination coverage, pertussis circulation cannot be controlled at all. The results question the efficacy of the present immunization programmes.

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Epidemia de tos ferina a pesar de la alta cobertura vacunal con vacuna antipertussis acelular

RESUMEN

Introducción: Se describe la epidemia de tos ferina en el año 2011 solo en casos confirmados. Se analizan datos sobre diagnóstico, epidemiología y antecedentes vacunales que podrían explicar las tendencias de la enfermedad.

Métodos: Estudio descriptivo de los casos confirmados de tos ferina notificados durante 2011 en la región del Vallès (población 1.283.000 habitantes). Los criterios de laboratorio para confirmación de un caso incluyen el aislamiento de *Bordetella pertussis* mediante cultivo en una muestra clínica o detección de *B. pertussis* por PCR en muestras nasofaríngeas.

Resultados: Fueron declarados 421 casos confirmados, siendo la incidencia más alta de los últimos 10 años (33 casos por 100.000 personas/año en 2011). La mayor tasa de incidencia fue en niños < 1 año de edad (448/100.000), seguido de los de 5–9 años (154/100.000). Los casos entre 2 meses y 1 año de edad estaban el 90% vacunados con DTaP según el calendario vacunal vigente en Cataluña para esta edad, entre 5–9 años el 87% estaban completamente vacunados con 5 dosis de DTaP. No hubo defunciones, pero el 8% de los casos fueron hospitalizados. La enfermedad fue más grave en < 1 año, y el 30% fueron hospitalizados a pesar de estar bien vacunados para su edad. Los casos de 5–9 años fueron más frecuentemente identificados como casos primarios en los hogares o grupos escolares.

Palabras clave:

Tos ferina

Vacuna

Epidemiología

Bordetella pertussis

Vigilancia

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Conclusión: A pesar de los altos niveles de cobertura vacunal, la circulación de la tos ferina no se puede controlar del todo. Los resultados ponen en duda la eficacia de los programas de inmunización actuales.

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Introduction

Classical pertussis is initially mild but develops into severe coughing fits characterized by an inspiratory whoop and frequently followed by vomiting. The cough gradually subsides over a period of weeks to months. Complications are more frequent among infants and include apnea, pneumonia, seizures and death.¹ In the past, pertussis was an important cause of childhood morbidity and mortality.² Fortunately, the burden of pertussis morbidity and mortality has been reduced over the last several decades. Although it seems evident that the vaccine does not provide sufficient protection, the vaccine has changed the epidemiology of pertussis and in the present vaccine era the disease is usually mild in immunized children and adults. In the last years a resurgence of pertussis has been documented in different countries all over the world with high coverage of DTaP vaccine (diphtheria, tetanus and acellular pertussis),^{3–8} including Catalonia, where the DTaP coverage in children is over 95%.⁹

Paediatric a-cellular pertussis vaccine (aP) has been used in Catalonia since 2002, replacing the whole-cell vaccines (wP) that were used before. The *B. pertussis* vaccine contains 3 antigens and consists of a five-shot series referred to as DTaP, recommended for children at ages two, four, six and eighteen months, and at four to six years old. Despite high vaccine coverage, pertussis is the most frequent vaccine-preventable childhood disease reported in Catalonia. The incidence has been increasing in recent years including fully vaccinated cases.¹⁰ Since 2003 the diagnostic methods available are *B. pertussis* culture and PCR for hospitals and PCR for primary healthcare centres.

We describe the pertussis epidemic based only on confirmed whooping cough cases reported during 2011 in the Vallès region (population 1,283,000), in the Barcelona northern metropolitan area. We have analyzed the available data on diagnostic, clinical, epidemiology and vaccine status in order to understand the factors that might explain the trends of the disease.

Methods

We conducted a descriptive study of the confirmed cases of pertussis from the Vallès region reported in 2011. Pertussis is a statutory notifiable disease in Spain. Cases from the Vallès region are reported to the Epidemiological Surveillance Unit of Vallès (ESUVV). A clinical or probable case was a person with an unexplained cough lasting at least 2 weeks with one of the following symptoms: paroxysms of coughing, inspiratory 'whoop', post-tussive vomiting or apnea. A confirmed case definition was the standard for the statutory reporting in Catalonia: it was a person who met the clinical definition and had laboratory confirmed pertussis by isolation of *B. pertussis* from a clinical specimen or detection of IS481 and IS1002 *B. pertussis* genes by real time polymerase chain reaction (PCR) in either nasopharyngeal swabs or nasopharyngeal aspirates. A confirmed case was also a person who met the clinical definition and was epidemiologically linked directly to a case confirmed by either culture or PCR. Cultures and serological test were not routinely made during this epidemic however swabs for PCR were available for all primary healthcare centres and hospitals. Until 2008 PCR testing was performed only by one laboratory, the Sant Joan de Déu Hospital Molecular Microbiology Department, but since 2009 the PCR test was more easily available because it was routinely provided by another laboratory (CATLAB).

A cluster was defined as two or more epidemiologically linked cases (same households, classroom, etc.). When clusters of pertussis were detected attempts were made to find the probable source of the infection, which is the primary case. The primary case was defined as the first individual in the household or school with a cough and met the clinical definition of pertussis.

Socio-demographic data, clinical and vaccine history, diagnostic tests, and epidemiological information were recorded by the ESUVV from all the cases with a standardized questionnaire. All reported cases were asked about other cases among household and family members. Parents or caregivers were interviewed when the cases were children. The information on vaccination was obtained from the computerized register of primary healthcare medical records: the number of DTP doses received until the symptoms onset and the time when the doses were administered. Cases which had received all the vaccination doses corresponding to their age were classified as well vaccinated. The Incidence rate (IR) by age group with 95% confidence interval was calculated. Census data from 2003 to 2011 were the source for the Vallès population. The diagnosis delay was the time between the onset of cough and diagnostic confirmation by PCR or culture. One-way analysis of variance (ANOVA) was used to determine whether there were any significant differences between the diagnosis delay means of different age groups.

Follow-up was undertaken on cases with a cough lasting less than 14 days or if they had been hospitalized. Household contacts and classmates of confirmed cases with cough were requested to visit the medical centre.

Data were entered into Health Department-maintained databases and analyzed by SPSS v18. A descriptive study was performed with demographic data (sex and age), vaccination status, diagnostic confirmation, diagnostic delay, hospitalization and clusters of all the confirmed cases reported to ESUVV during 2011.

Results

In 2011 were reported 515 clinical cases of pertussis in the Vallès region, a total of 421 cases (82%) met the definition of a confirmed case and were included in the study. The IR of reported and confirmed pertussis was 33 cases per 100,000 in 2011, that is the largest number of confirmed cases reported in the last ten years and an 11-fold increase from 2010 (Fig. 1). Females accounted for 57% of cases. Cases aged 5–9 years were the most frequently reported (28%), followed by those aged 1–4 years (20%) and <1 year (17%). Rates of pertussis were highest in children (Fig. 2) especially in infants aged <1 year with an IR of 448 per 100,000 (95% CI, 345.4–551.1) fol-

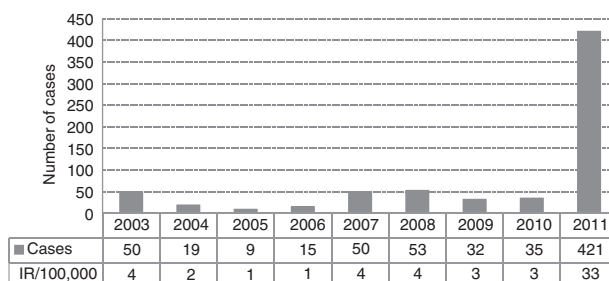


Fig. 1. Pertussis cases and incidence rate by year.

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