Vaccine 33 (2015) 5606–5612

Contents lists available at ScienceDirect

Vaccine

journal homepage: www.elsevier.com/locate/vaccine

Seroprevalence of mumps in an epidemic period in Medellín, Colombia

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ARTICLE INFO

Article history:
Received 22 April 2015
Received in revised form 26 August 2015
Accepted 31 August 2015
Available online 10 September 2015

Keywords:
Mumps
Seroepidemiological studies
Disease outbreaks
Medellín
Colombia

ABSTRACT

Objective: We related seroprevalence and outbreaks data in order to identify factors that could explain the occurrence of outbreaks despite high vaccination coverage in Medellín Colombia.
Methods: Samples from a population seroprevalence data obtained in 2009 in a random survey were analyzed. IgG levels were determined for mumps using 2 commercial tests of 2119 individuals aged 6–64 years. A comparative analysis was undertaken using age–specific mumps seroprevalence data and information of 98 epidemiological investigations of mumps outbreaks reported in 2009.
Results: Overall, seroprevalence was 91.6% (95% CI = 89.3–93.5%). The age-specific seronegativity was 20.3% and 20.6% in age groups 11–15 years and 16–20 years respectively. Individuals aged 6–20 years were the most affected during outbreaks. In individuals born in 2003, a year after the change in the booster schedule from 10 to 5 years, the proportion of unvaccinated individuals (14%) and those who received only one dose of MMR (45%) increased substantially. On average, 23.5 days elapsed between the onset of symptoms in secondary cases and the outbreak investigation.
Conclusion: Potential contributing factors for the occurrence of outbreaks of mumps were the relatively high prevalence of seronegativity among individuals aged 11–20 years, delays in investigation and control of outbreaks, and incomplete vaccination schedules.

1. Introduction

Mumps is a viral infection transmitted by direct contact or via airborne droplets from the nasopharyngeal secretions of infected individuals [1], particularly in conditions of overcrowding [2]. The incubation period varies between 1 and 4 weeks, and the transmission period lasts from 2 days before to 5 days after the onset of symptoms.

Mumps illness typically begins with non-specific symptoms including headache, low-grade fever, muscle pain and malaise. Swelling of the parotid gland occurs in 30–40% of cases and 50–60% of infections can be asymptomatic [3].

Orchitis is a complication of mumps that can occur in 20–30% of adolescents and adults, making it the most frequent extra-parotid complication. Oophoritis is another complication which can occur in 5% of women, and sterility can occur in rare cases. Aseptic meningitis can occur in 50–60%, usually without any lasting consequences [3].

The resurgence of this disease in the last decade is a worldwide concern. The worldwide annual incidence rate of mumps decreased steadily from more than 100 cases per 100,000 inhabitants in the pre-vaccination era to 9 cases per 100,000 inhabitants in 2000 [1,2].

However, subsequent outbreaks have been observed in countries such as the United Kingdom (2004–2006), Canada

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http://dx.doi.org/10.1016/j.vaccine.2015.08.088
0264-410X/

(2004–2007), Australia (2005–2007), the United States (2006) and the Netherlands (2007–2008) [4,5]. In Central and South America, outbreaks were reported in Uruguay (2005–2006), El Salvador (2006) and Venezuela (2007–2008) [6].

In Colombia, universal vaccination against measles, mumps and rubella (MMR) was introduced in 1995 for children aged 1 year. In 1998, the second dose of the MMR vaccine was included in the vaccination schedule for children up to 10 years of age and was lowered to 5 years of age since 2002. The average annual incidence rate of mumps decreased significantly from 48.7 mumps cases per 100,000 between 1991 and 1994 in the pre vaccine era [2] to less than 6 cases per 100,000 from 2001 to 2007. However, from 2008 to 2010 a resurgence of mumps occurred, the annual incidence rate increased to 13.7 in 2008, 21.6 in 2009 and 23.5 in 2010 [2]. In 2013, the average annual incidence was 16.7 cases per 100,000 inhabitants [7].

Medellín, the country's second most populous city, reported a reduction in the incidence of mumps after the introduction of universal vaccinations but then increased from 2008 to 2010 (the annual average incidence was 7 cases per 100,000 inhabitants from 2000 to 2007 to 106/100,000 in 2008, 83.1/100,000 in 2009 and 24.7/100,000 in 2010) [2].

MMR vaccine coverage was above 100% between 2005 and 2009 (2005 = 127.6%; 2006 = 114.7%; 2007 = 107.5%; 2008 = 109.6%; 2009 = 111.4%), implying imperfect coverage data due to population underestimation or over-reporting of vaccinated individuals [8].

Several hypotheses regarding the resurgence of mumps have been raised, such as the accumulation of susceptible individuals in low vaccination coverage regions, a greater opportunity for contact and transmission in conditions of overcrowding, and the existence of a lower level of herd immunity than expected, either due to reduced vaccine effectiveness or loss of protection over time [5,9,10]. At least five different attenuated mump virus strains have been used in MMR vaccine [11,12], with Jeryl Lynn and Urabe strains being the most commonly used; in addition to Rubini, Leningrad-3 and Leningrad-Zagreb; the latter is used in the vaccination program in Colombia. Recent outbreaks of mumps in highly vaccinated populations have shed doubts about the effectiveness of the vaccine [11]. WHO recommends that the Rubini strain vaccine should not be used in national immunization programs, based on a number of studies that have demonstrated substantially lower rates of seroconversion and effectiveness among recipients of Rubini strain vaccine compared with those vaccinated with Jeryl–Lynn or Urabe strains [13].

In order to identify some factors that may influence the occurrence of outbreaks of mumps in Medellín, we analyze the seroprevalence of IgG antibodies to the mumps virus in a population survey and compare it with epidemiological field investigation data from outbreaks which occurred at the same time.

2. Methods

A descriptive study of seroprevalence by age, gender and area was conducted using the data from a population survey performed in Medellín in 2009 and from epidemiological field research on mumps outbreaks reported during the same year.

2.1. Seroprevalence of mumps

The serum samples analyzed in this study were obtained during a rubella seroprevalence survey and conserved in the serum bank of the Laboratory of Public Health of the Regional Secretary of Health and Social Protection of Antioquia [14].

The original sample size was composed of 2124 males and females aged 6–64 years old residing in rural and urban areas of Medellín in 2009. A complex probabilistic sampling in 3 phases was used and the response rate was of 85.8% [14].

The vaccination status was retrieved from the immunization cards and registered in a questionnaire. It was completed by telephone calls and the central database of the Secretary of Health when necessary. The questionnaire included the self-reported history of mumps, asking to participants if the diagnosis was made by a doctor.

The level of antibodies in serum samples was determined using the automated VIDAS®MumpsIgG (MPG) test [15], which detects IgG for the mumps virus in human serum by the Enzyme Linked Fluorescent Assay (ELFA) method. According to the supplier (bioMérieux Laboratories), IgG values below the negative threshold (0.35) indicate that antibody levels are too low to indicate mumps virus immunity. Samples with values equal to or greater than the cutoff (0.50) were considered positive [15]. For samples with results in the gray zone (between 0.35 and 0.50) in the VIDAS®MumpsIgG (MPG) test, the IBL Mumps Virus IgG ELISA quantitative test was also applied because of its high specificity (96%) [16].

2.2. Mumps outbreaks in 2009

Characteristics of the outbreaks reported in 2009 to the surveillance systems of the Secretary of Health were described.

A case of mumps was defined as any person with an acute presentation of unilateral or bilateral parotid swelling, or swelling of other salivary glands lasting more than 2 days without another apparent cause [17,18]. According to national regulations, cases are clinically confirmed, no suspects or probable cases are reported, no laboratory tests are required except for cases with unclear clinical or large outbreaks where laboratory tests are ordered to 5–10 symptomatic patients diagnosed, including the index case [17].

An outbreak was defined according to the National Institute of Health: "the occurrence of a clinical case confirmed and contacts identified with similar symptoms of the index case in the same place" [17].

The outbreaks that occurred in educational institutions were stratified by the population size. The distribution of cases by age, gender, vaccination status and presence of complications were determined. It was not available the data of the population by age for the calculation of age-specific attack rate.

The effectiveness of outbreak control was established by calculating the time between the date of notification of a secondary case and the date of conducting epidemiological field investigation; directed to identify the chains of contagion and make a timely intervention. The vaccination status was also obtained through field research records, in which the vaccination card was transcribed.

Microsoft Access was used for data entry; IBM SPSS Statistics for Windows, Version 21.0 (SPSS Inc., Chicago, IL, US) and Microsoft Excel were used for data analysis. The categorical variables were compared using the Chi-square test, and the significance level was $p < 0.05$.

3. Results

3.1. IgG seroprevalence for mumps

A total of 2119 of 2124 samples were analyzed for mumps IgG antibody. There was insufficient serum for analysis 5 of the original samples, corresponding to 3 males (two from the urban area, aged 10 and 48 years, and one from the rural area aged 14 years) and 2