

Original Article



Investigation of a Mumps Outbreak in a Dental Clinic at a University Hospital

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ABSTRACT

Background: The Korean Society of Infectious Diseases recommends non-mandatory vaccination of newly employed healthcare workers (HCWs) with 2 measles–mumps–rubella (MMR) vaccine doses. Here, we aimed to investigate the seroprevalence of mumps among HCWs exposed to index patients with mumps and the efficacy of MMR vaccination as postexposure prophylaxis (PEP) when a mumps outbreak was encountered among HCWs in a tertiary university hospital in Korea.

Materials and Methods: Four HCWs were diagnosed with mumps over a 4-day period in January 2016. Three were working at a dental clinic and one visited the clinic on the day of symptoms onset of the first patient. We investigated all HCWs who either worked in that dental clinic, visited the clinic, or being within 1.5 meter of the patients with mumps without wearing surgical masks. Seventy HCWs were exposed to 4 HCWs with mumps. We interviewed all the exposed HCWs to investigate mumps infection and MMR vaccination history; they were all tested for mumps IgG.

Results: Of the 70 exposed HCWs, 56 (80%) were females; the median age was 34 years (range 21–59 years) and 3 had a history of mumps infection. The vaccination status verification of mumps among the HCWs was unavailable. As for serologic testing, 54 (77.1%) were seropositive. Seropositivity rate for the mumps virus in males was significantly lower than that in females (50.0% *vs.* 83.9% respectively, $P = 0.007$). A lower seroprevalence of mumps was observed among HCWs aged ≥ 40 years than those aged < 40 years; however, this difference was not significant (65.2% *vs.* 83.0%, $P = 0.096$). During the initial intervention, all exposed HCWs were vaccinated because the turnaround time for serologic testing was expected to be > 2 days. Thirty-four (62.9%) of 54 seropositive HCWs and 16 seronegative HCWs were administered MMR vaccines as PEP and following this, no additional cases of mumps were encountered during the maximum incubation period.

Conclusion: Of the exposed HCWs, 77.1% were mumps-seropositive. Seropositive rates differed according to factors such as age and sex. Eligible HCWs received a MMR vaccine as PEP and no additional mumps cases occurred during the incubation period. It was useful in our infection control activities during the mumps outbreak.

Keywords: Mumps; Measles-mumps-rubella vaccine; Healthcare workers

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Conflict of Interest
 No conflicts of interest.

Author Contributions
 Conceptualization: JEL, KHK. Data curation: JEL, SOL, JSK, JY, KHK. Funding acquisition: KHK. Investigation: JEL, JY, KHK. Supervision: JY, KHK. Writing - original draft: JEL, KHK. Writing - review & editing: JEL, SOL, JSK, JY, KHK.

INTRODUCTION

Mumps is a viral infection caused by a *Paramyxovirus*, which is usually transmitted by contaminated droplets [1, 2]. It causes non-specific influenza-like symptoms, followed by unilateral or bilateral parotid gland swelling [2, 3]. Rarely, it can cause severe complications, such as encephalitis, meningitis, orchitis, and oophoritis [2-4]. After the universal use of the mumps vaccine and the measles–mumps–rubella (MMR) vaccine, the incidence rate of mumps dramatically declined [1, 5, 6]. However, multiple mumps outbreaks have occurred worldwide even among heavily vaccinated populations [1, 5].

In Korea, the incidence rate of mumps has steadily increased since 2007 [1, 5]. The Korean Society of Infectious Diseases has recommended that newly employed healthcare workers (HCWs) recommended to be vaccinated with 2 doses of MMR vaccine, but it is not mandatory [7]. MMR vaccination as a postexposure prophylaxis (PEP) in an outbreak setting has not yet been recommended [1]. Recently, we encountered a mumps outbreak among HCWs in a tertiary university hospital in Korea and thereby conducted a serosurvey for the mumps and infection control among patients with mumps and HCWs who were exposed to the infected patients. We conducted this survey to better understand the feasibility of MMR vaccination as PEP.

MATERIALS AND METHODS

1. Outbreak Investigation and Study Subjects

Four cases of mumps were encountered at Pusan National University Hospital (PNUH) over a period of 4 days in January 2016. Three of the 4 patients with mumps were HCWs working at the dental clinic. The fourth patient was the HCW who visited the dental clinic on the day of symptoms onset of the first patient (Fig. 1). Considering the incubation period (12–25 days)

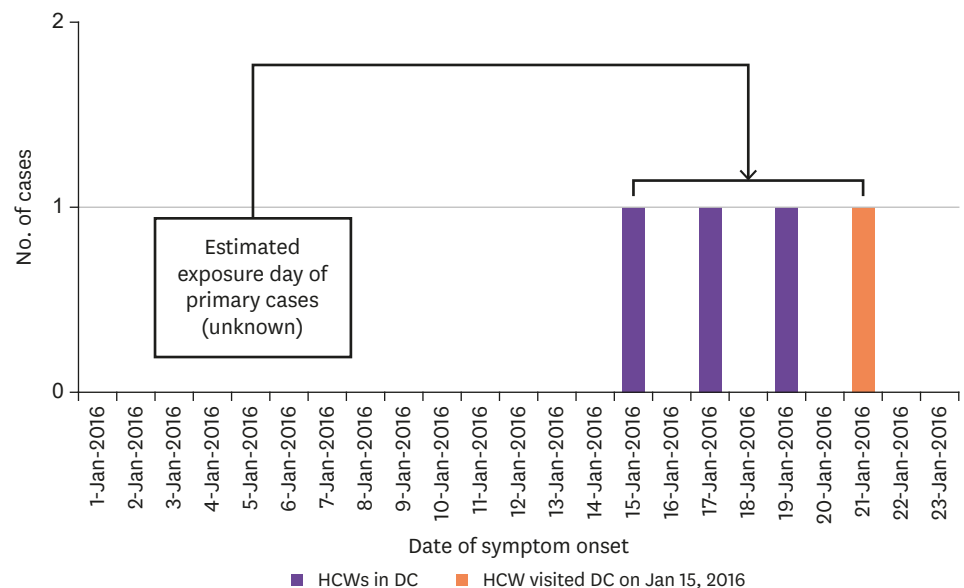


Figure 1. The epidemic curve of 4 mumps cases encountered at Pusan National University Hospital (January 15–21, 2016). Three HCWs were working at the dental clinic with unknown exposure date and the fourth patient was the HCW who visited the dental clinic on the first day of the outbreak. HCW, healthcare worker; DC, dental clinic.

Table 1. Clinical characteristics of 4 patients with mumps encountered at a tertiary hospital in 2016

Patient No.	Patient Age, years/sex	Occupation	Date of symptom Onset	Date of diagnosis	Diagnostic method	Clinical signs	No. MMR vaccine doses received	Results of mumps-serologic tests	
								IgM	IgG
1	35/M	Doctor	15-Jan-2016	18-Jan 2016	Clinical	Fever, bilateral facial swelling	Unknown	-	+
2	36/F	Nurse	17-Jan 2016	18-Jan 2016	Clinical	Fatigue, unilateral facial swelling	Unknown	-	+
3	24/F	Nurse	19-Jan 2016	19-Jan 2016	Clinical	Unilateral facial swelling	Unknown	-	+
4	29/F	Administrator	21-Jan 2016	22-Jan 2016	Clinical	Unilateral facial swelling	Unknown	-	+

MMR, measles-mumps-rubella; IgM, immunoglobulin M; IgG, immunoglobulin G; M, male; F, female.

of mumps, patients who visited the dental clinic from December 20, 2015 to January 9, 2016 were investigated; however, no index patients were identified [1]. Four HCWs with mumps had typical clinical manifestation of mumps. All four patients had positive IgG serologic results and negative IgM serologic results. We could not do the laboratory confirmation tests of mumps by cell culture, polymerase chain reaction or neutralizing antibody test. All 4 patients were diagnosed clinically by classic symptoms of parotitis. None had documented receipt of MMR vaccines and prior mumps infection (Table 1).

Close contacts were defined as all HCWs who worked in the dental clinic, visited the dental clinic 2 days prior to the onset of symptom of the first mump patient (Fig. 1), and being within 1.5 meter without wearing surgical masks from 2 days before symptoms appear through 5 days after symptoms appear of the patients.

During the outbreaks, 70 HCWs were exposed to patients with mumps. We interviewed all the exposed HCWs to check for a history of mumps infection and MMR vaccination. All exposed HCWs were tested for mumps IgG. During the maximal incubation period (25 days), the mumps symptom onset of all exposed HCWs were monitored.

2. Assay for detecting mumps IgG

For detecting mumps IgG by enzyme immunoassay, we used a commercially available assay kit (LIAISON® Mumps IgG kit, DiaSorin, Saluggia, Italy) with 98.2% specificity and 98.5% sensitivity [8]. A negative or equivocal antibody titer determined by enzyme immunoassay was considered seronegative.

3. Definition of postexposure prophylaxis

PEP was defined as a single dose of MMR vaccine administered to HCWs exposed within the first 5 days of 4 HCWs' onset of mumps, diagnosed by infectious diseases physicians [4].

4. Statistical analysis

Statistical analyses were performed using SPSS for windows version 22.0 (SPSS Inc., Chicago, IL, USA). We performed χ^2 tests for determining the effects of sex, age, and occupation on seroprevalence. Categorical variables were described using frequencies and percentiles. All results were considered significant by $P < 0.05$.

5. Ethics statement

This study was approved by the Institutional Review Board of PNUH (No. H-1812-012-074), and the requirement for obtaining informed consent was waived.

RESULTS

1. Characteristics of subjects

Of the 70 HCWs who were exposed to 4 patients with mumps, 56 (80%) were females and 14 (20.0%) were males. The median age was 34 years (range 21–59 years). These HCWs were grouped according to age; 20 (28.6%) were between 20 and 29 years, 27 (38.6%) were between 30 and 39 years, 14 (20.0%) were between 40 and 49 years, and 9 (12.9%) were ≥50 years. The subjects comprised 12 (17.1%) doctors, 24 (34.3%) nurses, 14 (20%) medical technicians, and 20 (28.6%) administrators (Table 2).

2. Vaccination status verification and seroprevalence of virus antibodies in healthcare workers

Of the 70 exposed HCWs, 20 (28.6%) replied that they had received more than 1 dose of MMR vaccine; 11 (15.7%) replied that they did not receive MMR vaccination; and 39 (55.7%) did not remember their MMR vaccination history. We also checked the MMR vaccination record of exposed HCWs via the Infectious Diseases Web Statistics System of the Korea Centers for Disease Control and Prevention (<http://is.cdc.go.kr>). Of the 39 HCWs who did not remember their vaccination history, 3 had received MMR vaccination. Of the 20 HCWs who had replied that they received more than 1 dose of MMR vaccination, only 1 had a reliable vaccination record. However, most of HCWs' records were not registered in the web system, and it was difficult to find accurately the MMR vaccination history. Among all HCWs, 3 had a history of mumps infection in their childhood. Because we could not find accurate record of the vaccination history nor mumps history, we checked serological testing for all 70 HCWs. As per serologic testing, 54/70 (77.1%) were seropositive. Seropositivity rate for the mumps virus in males was significantly lower than that in females (50.0% vs. 83.9%, $P = 0.007$). Age-specific seroprevalence rates were as follows: 20–29 years, 80%; 30–39 years, 85.2%; 40–49 years, 64.3%; and ≥50 years, 66.7% ($P = 0.399$). A lower seroprevalence of mumps was observed among HCWs aged ≥40 years; however, it was not significant (65.2% vs. 83.0%, $P = 0.096$). Seropositivity rates were 75%, 87.5%, 71.4%, and 70% in doctors, nurses, medical technicians, and administrators, respectively ($P = 0.507$) (Table 2).

3. Postexposure prophylaxis and result of intervention

During the initial intervention, 22 among 23 HCWs who worked in the dental clinic and exposed to the 3 patients working at a dental clinic were vaccinated except for one HCW who

Table 2. Characteristics of the hospital employees exposed to patients with mumps according to mumps IgG status

	Total (n = 70)	Mumps IgG status, n (%)		P-value
		Positive (n = 54)	Negative or equivocal (n = 16)	
Sex				0.007
Male	14	7 (13.0)	7 (43.8)	
Female	56	47 (87.0)	9 (56.2)	
Age (year)				0.399
20–29	20	16 (29.6)	4 (25.0)	
30–39	27	23 (42.6)	4 (25.0)	
40–49	14	9 (16.7)	5 (31.3)	
≥50	9	6 (11.1)	3 (18.7)	
Occupation				0.507
Doctor	12	9 (16.7)	3 (18.8)	
Nurse	24	21 (38.9)	3 (18.8)	
Medical technician	14	10 (18.5)	4 (25.0)	
Administrator	20	14 (25.9)	6 (37.4)	

IgG, immunoglobulin G

preparing for pregnancy regardless of the results of mumps serology test between January 19 and January 20, 2016, because the turnaround time for serologic testing was expected to be >2 days. At the time of the turnaround time was expected to be <24 h, 21 of 47 HCWs, who were exposed to the fourth patient or visited the dental clinic 2 days prior to the onset of symptom of the first patient, were vaccinated regardless of the results of mumps serology test on January 22, 2016. The others were vaccinated according to the results of mumps serology, 7 seronegative HCWs were vaccinated between January 22 and January 25, 2016. Thus 23 HCWs were vaccinated on January 22, 2016, and 5 HCWs were vaccinated on January 25, 2016. Fifty (71.4%) among 70 eligible HCWs received a postexposure dose of MMR vaccine. Thirty-four (62.9%) of 54 seropositive HCWs received a single dose of MMR vaccine as PEP. PEP was administered to eligible HCWs exposed within the first 5 days of 4 patients' symptom onset. No additional mumps cases occurred during the maximum incubation period (25 days) [1].

DISCUSSION

In this study, 4 HCWs were diagnosed with mumps over 4 days, January 21, 2016. Total 70 HCWs were exposed. All 4 of the patients did not recall the history of MMR vaccination but had positive IgG serologic results; they had probably received ≥ 1 MMR vaccine. Outbreaks of mumps were reported worldwide among vaccinated populations [1].

In Korea, mumps vaccine was introduced during the early 1980s and was included in the National Immunization Program as a combined MMR vaccine in 1985 [5, 9, 10]. Since 1997, 2-dose MMR vaccination at 12–15 months and at 4–6 years of age was recommended [5, 9, 10]. After introduction of universal vaccination of mumps and MMR, the incidence of mumps dramatically declined [1, 5, 11]. However, multiple mumps outbreaks have occurred worldwide among highly vaccinated populations [1, 5, 11]. In Korea, the incidence rate of mumps outbreaks has steadily increased since 2007, with a sharp rise in 2013 [5].

Vaccine effectiveness has been reported in several studies. After the first dose, vaccine effectiveness for the Jeryl Lynn strain vaccine ranged from 72.8% to 91%; Urabe strain vaccine, 54.4% to 93%; and Rubini strain vaccine, ~33% [5, 12]. The effectiveness of the second MMR vaccine dose was greater than that of the first dose [5, 11]. However, the actual effectiveness in outbreaks settings was 64–66% for the primary dose and 83–88% for the second doses of the Jeryl Lynn strain vaccine [5, 11]. MMR vaccines containing the Rubini strain have the lowest efficacy (0–33%), and numerous outbreaks occurred worldwide after the introduction of the Rubini strain vaccine [5, 11]. Thus, the Rubini strain vaccine was discontinued according to the recommendation by the World Health Organization in 2002 [5, 9–11]. Accordingly, MMR vaccines containing the Rubini strain were withdrawn in Korea during 2002 [5, 10]. Considering that the Rubini strain vaccine was used in Korea from 1997 to 2002, individuals born during 1991–2001 could have been vaccinated at least once with the Rubini strain vaccine and might be considered susceptible individuals [5, 11]. In this study, the seropositivity rate of mumps was 77.1%. Age-specific seroprevalence rates were as follows: 20–29 years, 80%; 30–39 years, 85.2%; 40–49 years, 64.3%; and ≥ 50 years, 66.7%. The seroprevalence of mumps among the Korean population are insufficiency [5]. In the previous study, the seroprevalence mumps of young Korean soldiers was 81.1% in 2010 [13]. In the report of the National Immunization Survey conducted by the National Institute of Health in 2002, the seropositivity rate of mumps was about 80% in the youth over 9 years [14]. It was impossible to analyze the effect of the use of Rubini strain vaccine on the seropositive rate of mumps [14]. In this study, HCWs who were

born between 1991 and 2001 who were expected to have vaccinated at least once with the Rubini strain vaccine were more seropositive than the rest (87.5% vs. 74.0%, $P = 0.688$). On the other hand, the seropositivity rate for the mumps virus in males was significantly lower than that in females (50.0% vs. 83.9%, $P = 0.007$). Moreover, the seropositivity rate in HCWs aged ≥ 40 years was lower than that in HCWs aged < 40 years; however, this difference was statistically non-significant (65.2% vs. 83.0%, $P = 0.096$). Males were considered to have lower seropositivity rates than females owing to their older age. Here, the proportion of males aged ≥ 40 years was higher than that of females (57.1% vs. 26.8%, $P = 0.031$). Some studies conducted in the United Kingdom and Europe revealed lower vaccine effectiveness in those who received MMR vaccine more than 10 years before the outbreak and higher incidence rates of mumps with increasing time since vaccination [4, 5]. Thus, seropositivity rates are closely related to the elapsed time since vaccination rather than the vaccine strain. According to the adult immunization schedule recommended by the Korean Society of Infectious Disease, 2012, new HCWs under the age of 40 years were recommended additional MMR vaccination without any evidence of immunity [7]; however, there are no guidelines for existing HCWs. In our study, seropositivity of mumps virus was lower in subjects aged ≥ 40 years than in those aged < 40 years. Therefore, a review of the immunization guideline established in 2012 as well as the creation of a new immunization guideline for existing HCWs is required.

Thirty-four (62.9%) of 54 seropositive HCWs and seronegative HCWs received MMR vaccines as PEP. No additional mumps cases occurred during the maximum incubation period. Unlike measles, the mumps vaccine as PEP is not effective in preventing infection [15]. Nonetheless, MMR vaccine as PEP can be used as an outbreak control measure [4, 5]. If infection does not occur, the vaccine should boost antibody titers high enough to prevent infection [5]. If infection occurs, PEP may lead to mild clinical outcomes [4, 5, 16-18].

This study has some limitations. First, our data were obtained based on a small number of HCWs. Second, the vaccination status verification of mumps among HCWs was not available. Third, our study did not include an unvaccinated control group, since all the eligible HCWs received a postexposure dose of MMR vaccine. Fourth, we could not do the laboratory confirmatory tests of mumps cases, and the specific pathogen of parotitis was not identified. Fifth, there was no definition of MMR vaccine as PEP in mumps outbreak setting and lack of defined previous studies. Finally, since no index patients were identified, HCWs who exposed to the index patients did not receive PEP that fit the definition. Only eligible HCWs were exposed to 4 HCWs with mumps received a single dose of MMR vaccine as PEP.

Eligible HCWs received a MMR vaccine as PEP and no additional mumps cases occurred during the maximum incubation period. PEP was useful in our infection control activities during the mumps outbreak. Therefore, the MMR vaccine as PEP can be considered during the mumps outbreak in a hospital setting.

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