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Case Report

Estimation of secondary measles transmission from a healthcare worker in a hospital setting

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SUMMARY

Measles among healthcare workers (HCWs) is associated with a significant risk of nosocomial transmission to susceptible patients. When a measles case occurs in the healthcare setting, most guidelines recommend exhaustive measures. To evaluate the effects of measures against measles transmission in the healthcare setting precisely, it is essential to determine whether secondary transmission generally occurs. This study describes, for the first time, the actual secondary transmission rate for a measles-infected HCW in a ward with no special air ventilation capacity. The routine treatment of a number of immunocompromised patients occurs in this ward, and thus patients as well as HCWs have a thorough understanding and practice of standard and extended precautions. Our paired serum sample study revealed that none of the people in the ward exposed to the HCW at the catarrhal stage over a period of 4 days exhibited elevated levels of antibodies against measles. We suggest that strict adherence to standard and expanded precautions among patients and HCWs may be effective for preventing the transmission of a highly airborne disease, such as measles.

1. Introduction

Measles among healthcare workers (HCWs) is associated with a significant risk of nosocomial transmission to susceptible people, including non-immune colleagues and immunocompromised patients.[1] Although measles is effectively prevented by two-dose vaccination, measles outbreaks still occur in the healthcare setting.[2] Therefore, to prevent nosocomial secondary measles transmission, practical and appropriate measures for measles prevention should be expected in healthcare facilities.

Measles is assumed to be a highly contagious viral disease spread by direct contact, large droplets, or airborne transmission, and even brief exposure to an infected person can easily lead to spread of the disease.[1] Therefore, when a measles case occurs in the healthcare setting, most guidelines recommend exhaustive measures, including contact tracing, isolation and exclusion of suspected cases, laboratory testing, and post-exposure prophylaxis with measles vaccination.[1]

The National Institute of Infectious Diseases in Japan published guidelines for the prevention of measles and management of HCWs in 2013. The guidelines require (1) documentation of previous history and vaccination for measles and (2) serological evidence of measles (persons with only a previous history of measles), and recommend (3) vaccination (persons with no evidence of a two-dose vaccination or lack of measles immunity). Many nosocomial measles outbreaks have been reported, nonetheless, but the actual secondary transmission rate from measles-infected HCWs to patients is unknown.[1,3] Therefore, we evaluated, for the first time, the secondary transmission rate of measles to exposed HCWs and patients by a measles-infected nurse performing routine care in the ward by comparing paired serum samples.

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2. Case report

On March 31, 2003, a 20-year-old woman was brought to Yamagata University Hospital in Japan with a fever and facial rash. She was suspected of having measles, and was thus placed in a private room. A 31-year-old nurse obtained a history of the present illness and a blood sample from the patient. On April 1, the patient was diagnosed with measles based on the presence of measles-specific IgM antibodies. The nurse developed a fever on April 9 and a rash on April 12, and was promptly diagnosed with measles and isolated. She had been on duty in ward A from April 9 to 12. Ward A has 40 beds for patients with neurological, endocrine, and blood disorders. It is ventilated by a common building air-conditioning system in which the air is mixed with fresh outdoor air and recirculated.

Contact tracing was initiated on April 12. All people who had come into contact with the measles-infected nurse were listed, traced, and questioned about previous natural measles onset or vaccination against measles. Two groups of people exposed to measles were identified: HCWs and patients. Contact HCWs were those who had worked in ward A from April 9 to 12. Contact patients were those who had received nursing care from the nurse in ward A during the same period.

Serological testing for measles-specific antibodies was performed using a particle agglutination assay. Secondary measles transmission was defined as a four-fold increase in the measles IgG titer in paired serum samples. The first serum sample was obtained from the exposed subjects on April 12, and, when possible, a second sample was collected 4 weeks later. Prophylactic therapy with a measles-containing vaccine was recommended for susceptible exposed HCWs and patients.

This study was reviewed and approved by the Yamagata University review board.

Forty-seven HCWs were identified as having been exposed to the nurse: 22, including the index case, were nurses, 17 were medical doctors, six were medical students, and the other two were a nurse assistant and a pharmacist (Table 1). Four susceptible HCWs, including the index case, were identified. The infected nurse had been told by her mother that she had been vaccinated against measles, and the remaining three cases were unvaccinated. They were removed from duty in ward A and stayed at home during the incubation time. None received measles-containing vaccine.

A total of 37 patients admitted to ward A were identified as having been exposed to the nurse (Table 1): 20 had blood disorders (including acute leukemia, malignant lymphoma, and multiple myeloma), nine had endocrine and metabolic disorders (including pituitary adenoma and diabetes mellitus), and eight had neurological disorders (including multiple sclerosis and myasthenia gravis). One susceptible 25-year-old patient was a blood stem cell transplantation donor. This patient was uncertain of her measles immune status and was promptly discharged from ward A and stayed at home during the incubation time. She received no measles-containing vaccine.

Eighty-seven first serum samples were obtained from all contact subjects, defined as having been exposed to the nurse (87/87: 100%); 67 secondary serum samples were obtained (67/84: 80%; Table 1). Seventeen secondary serum samples from the identified patients were lost due to the discharge of the patients from ward A. The paired serum sample analysis showed no significant increase in the measles IgG titer in the secondary sera other than in the index nurse (Table 1). A follow-up study also showed no nosocomial transmission in ward A.

Table 1
Results of the paired serum sample analysis in ward A

Occupation	First serum sample Immune to measles/ number (number non-immune) (%)	Second serum sample Secondary response/ tested number
Nurse (n=22)	20/22 (2) (91%)	1/22 (1: index case)
Nurse assistant (n=1)	1/1 (0) (100%)	0/1
Medical doctor (n=17)	17/17 (0) (100%)	0/17
Medical student (n=6)	5/6 (1) (83%)	0/6
Pharmacist (n=1)	1/1 (0) (100%)	0/1
Patient (n=37)	36/37 (1) (97%)	0/20
Total (n=84)	80/84 (4) (95.2%)	1/67 (1: index case)

3. Discussion

HCWs are at higher risk of exposure to measles than the general population and a HCW with measles will inevitably result in large numbers of exposed high-risk patients.[1] Although delays occurred in the diagnosis of measles in our case, our paired serum sample study revealed that none of the people exposed to the nurse during the catarrhal stage were affected by secondary transmission in ward A. This finding suggests that airborne transmission of measles is not always a predominant route and could be less frequent than transmission via contact or droplet routes. Indeed, ward A has no special air handling or ventilation capacity, and many immunocompromised patients are treated routinely, but there was no evidence of secondary measles transmission from the measles-infected nurse. In ward A, routine education, training, and practice of standard and expanded precautions for patients as well as HCWs are performed. Therefore, patients and HCWs undertook thorough standard and extended precautions, including strict adherence to alcohol-based hand rub and masks. In contrast, Fujisaki et al. reported that in the same class of university setting, 42% of students presented with secondary measles transmission from the index case.[4] This difference in prevalence of secondary transmission to that found in our study may be due to variations in the standard precautions taken among the two groups.

The most effective preventive measure against measles is two-dose vaccination.[1] The guidelines recommend that all HCWs have documentation or serological evidence of measles immunity.[1] In this study, the incidence of measles antibodies in HCWs in ward A was 94% (45/48). One year later, a larger scale serology survey of measles was performed among 686 HCWs (370 nurses, 240 medical doctors, and 89 medical assistants) at our hospital, and the incidence of immunity was 91% (627/686).[5] Both studies showed that susceptible HCWs were younger than 40 years old.[5] The vaccination coverage of measles among all HCWs was unknown, but in susceptible HCWs, the vaccination coverage was 60% and the remaining 40% was uncertain.[5] Since then, serological testing has been performed for new HCWs to evaluate their immune status before allowing them to work or train in the ward, and vaccination of all susceptible HCWs is now recommended.[5]

Susceptible patients are also a risk or source for measles transmission in healthcare facilities, and this remains an unresolved and significant problem. Susceptible patients may be classified as unvaccinated or immunologically incompetent due to illness or treatment. In the present study, we detected an unvaccinated susceptible patient in ward A. To attain complete measles elimination in healthcare settings, two-dose vaccination of every susceptible subject as well as all HCWs should be implemented.

In conclusion, although delays occurred in the diagnosis of measles in our case, our paired serum sample study revealed no secondary transmission of measles by an infected nurse working in the ward. This finding suggests that strict adherence to standard

and expanded precautions among patients as well as HCWs is essential and effective. Ultimately, only high vaccination coverage among HCWs can really prevent the hospital setting.

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Conflict of interest: The authors declare no conflict of interest.

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