Specific Features of the Contact History of Probable Cases of Severe Acute Respiratory Syndrome

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Objective   To describe the specific features of the contact history of probable cases of severe acute respiratory syndrome (SARS) in Beijing.   **Methods**   Data of SARS cases notified from the Beijing Municipal Center for Disease Control and Prevention (BCDC) and supplemented by other channels were collected. All the data were analyzed by descriptive epidemiology.   **Results**   ①The number of probable cases with contact history was significantly higher than the excluded cases. ②The proportion of probable cases with contact history descended with epidemic development, but this situation did not occur in health care workers (HCWs). ③The fatality rate of probable cases with contact history was significantly higher than the cases without contact history (OR=1.489). ④The proportion of probable cases with contact history was 85.86% among health care workers, which was significantly higher than that of non-health care workers (85.86% v.s. 56.44%, OR=4.69).   **Conclusions**   ①The susceptible persons with contact history may not get infected, and the contact history is just a sufficient condition of infecting SARS; ②There are 3 conceivable reasons for the descending trend of the proportion in probable cases with contact history; ③The contact history is one of the risk factors of the death of SARS cases; ④The risk of contacting with SARS among health care workers is approximately 5 times higher than that of non-HCWs.

Key words: SARS; Probable cases; Contact history; Beijing

INTRODUCTION

Severe acute respiratory syndrome (SARS), an atypical pneumonia highly transmissible to health care workers is a new clinical entity caused by a novel coronavirus[1]. In November 2002, SARS firstly emerged in Guangdong Province of China, and soon was transmitted into the Hong Kong Special Administrative Region, Vietnam and some other countries. The first case of SARS in Beijing was identified in March, 2003. The prevalence of SARS increased up to the peak in April, which made Beijing the most serious epidemic municipal city over the world. Some important issues regarding its transmission, infection control, diagnosis and management have not been fully understood[2], and the transmission mechanism of SARS-CoV is unclear at present. SARS appeared to spread by close person-to-person contacts. Most SARS cases involved people who cared for or lived with individuals with SARS, or people who had direct contacts with infectious materials (e.g. respiratory secretions) from a person with SARS. The rapid spread of the disease among health care workers in Hong Kong and Hanoi indicated that the SARS-CoV was highly infectious[3]. It was reported that the incidence rate of SARS in the people who contacted SARS patients was about 50%[4]. To make a better understanding of the distribution of SARS, a preliminary analysis was made in this study.

MATERIALS AND METHODS

Data Source

Database of notification of infectious diseases in Beijing and database for individual SARS cases were linked by name and reported time. The linked databases were checked strictly to modify the wrong data and to exclude the repeated data. On June 24, 2003, when Beijing was removed by WHO from the list of areas with recent local transmission[5], there were a cumulative total of 2 521 probable SARS

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cases in Beijing. Since 236 cases who did not report their contact history were excluded, 2 285 valid SARS cases were included in the analysis.

Case Definition

The Chinese Ministry of Health defined probable and suspected SARS cases according to the following criteria :1) epidemiologic history (either contact with other SARS patients or exposure to a SARS-affected area), 2) symptoms and signs of fever and respiratory illness, 3) normal or decreased leukocyte counts, 4) chest radiograph abnormalities, and 5) absence of substantial improvement with antibiotic treatment[6] (Table 1).

TABLE 1

Case Definition for Severe Acute Respiratory Syndrome in China on May 3, 2003

Category	Criteria[a]
Probable	1.1+2+4, or
	1.1+2+4+5,or
	1.2+2+3+4,
Suspected	1.1+2+3,or
	1.2+2+4,or
	2+3+4

Note. [a]1. Epidemiologic history. 1.1: having close contact with a patient, or being a member of infected cluster, or having infected other persons; 1.2: Having visited or resided in cities or areas where SARS cases were reported with secondary transmission during the 2 weeks before onset of the disease. 2. Symptoms and signs of febrile respiratory illness. 3. Normal or decreased leukocyte counts. 4. Chest X-ray changes. 5. Lack of response to antibiotic treatment.

Close Contacts

Close contacts with SARS patients were defined as persons who shared meals, utensils, a residence, a hospital room, or a transportation vehicle with a suspected SARS patient or as persons who visited such a patient in a period of 14 days before the patient's onset of symptoms. In addition, persons with potential contact with the secretions of a SARS patient during the patient's treatment or care were considered as close contacts.

Statistical Methods

Database was set up utilizing the Microsoft EXCEL. Descriptive epidemiological methodology was used, and SPSS software was employed for statistical analysis.

RESULTS

Demographic Characteristics of Probable SARS Cases

There were a total of 2 521 probable SARS cases in Beijing, including 1 279 males (50.73%) and 1 242 females (49.27%). No gender difference was found. Most of the cases aged from 20 to 40 years. Among all the age groups (10 age groups), the cases aged from 20 to 29 years accounted for the highest proportion.

Contact History of Probable and Excluded Cases

Based on the valid data, 61.36% of the probable cases had a contact history with SARS patients while 35.58% of the excluded cases had a contact history. The proportion of cases with a contact history in the probable cases was significantly higher than that in the excluded cases (χ^2=302.348, P=0.000).

TABLE 2

Distribution of the Probable and Excluded Cases by Contact History in Beijing

Contact History	Probable Cases		Excluded Cases		Total	
	No.	%	No.	%	No.	%
Yes	1 402	61.36	804	35.58	2 206	48.54
No	883	38.64	1 456	64.42	2 339	51.46
Total	2 285	100.00	2 260	100.00	4 545[*]	100.00

Note. [*]χ^2=302.348, P=0.000.

Distribution by Date of Onset

The first SARS case in Beijing was identified on March 8, 2003, and the last case was identified on May 28, 2003. The distribution of contact history by date of symptom onset is shown in Fig. 1, and the dynamic proportion of contact history with the varied time is showed in Fig. 2.

Distribution of Contact History by Epidemic Stage

Based on the dates of symptom onsets, the epidemic of SARS in Beijing was divided into 5 stages: imported stage (before March 31), spreading stage (April 1 to April 15), peak stage (April 16 to May 5), decreasing stage (May 6 to May 19), terminating stage (after May 20). The distribution of contact history in each stage is shown in Fig. 4. With the development of the outbreak, the proportion of the probable cases with contact history began to decrease.
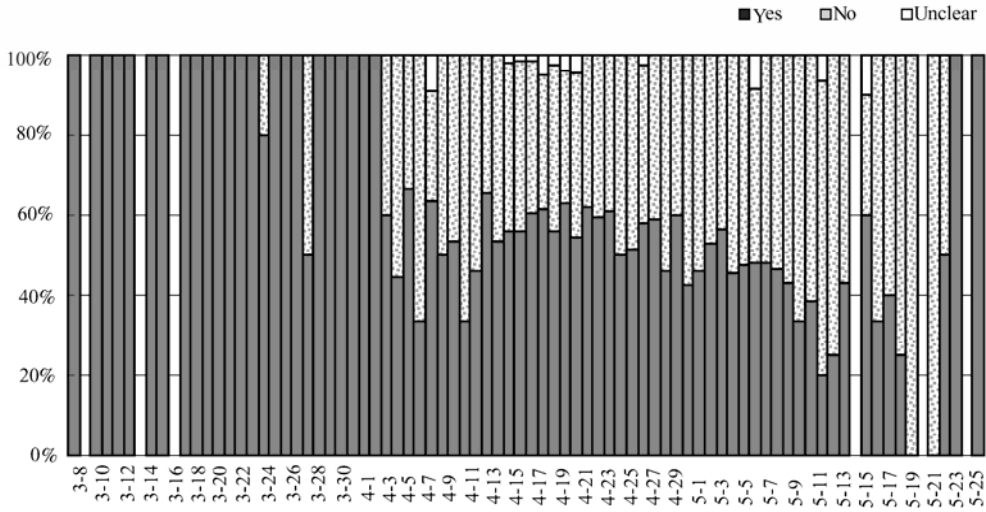
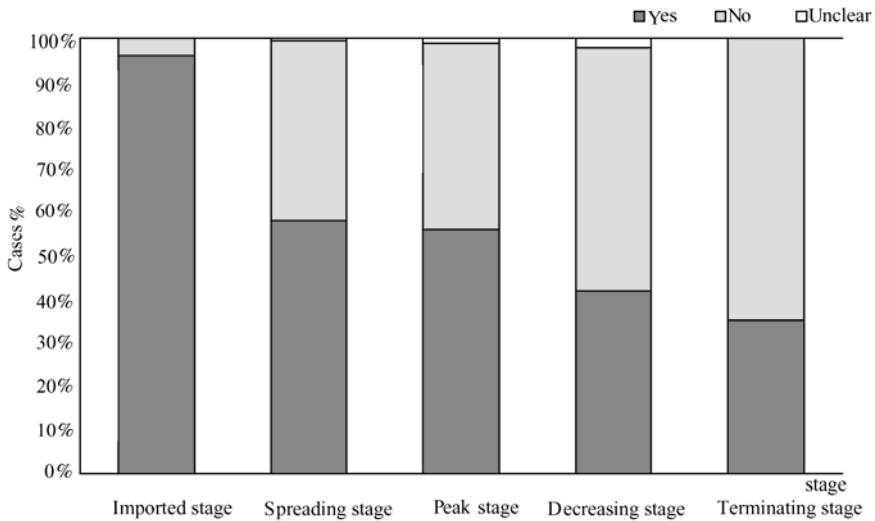FIG. 1. The distribution of contact history by date of SARS onset in Beijing.

FIG. 2. Distribution of contact history in different stage.

Association of Contact History and Prognosis

A total of 192 probable cases died of SARS in Beijing, of whom 165 registered their contact history. The contact history significantly influenced the prognosis (χ^2=5.217, P=0.022). The cases with a contact history were more likely to die of SARS than those without contact history. The elevated risk was 1.49 (95% CI: 1.06-2.10) (Table 3).

TABLE 3

Correlation Between Contact History and Prognosis of Probable SARS Cases in Beijing

	Died Cases		Survived Cases		Total	
	No.	%	No.	%	No.	%
Yes	115	69.70	1 287	60.71	1 402	61.36
No	50	30.30	833	39.29	883	38.64
Total	165	100.00	2 120	100.00	2 285[*]	100.00

Note. [*]χ^2=5.217, P=0.022.

Characteristic of Contact History Among Health Care Workers

Of health care workers 85.86% had contacts with SARS patients, which was significantly higher than non-health care workers (56.44%). Health care workers were at higher risk of being infected than non-health care workers (OR=4.69, 95% CI: 3.47-6.34). The proportion of cases with a contact history in health care workers did not decrease with the epidemic development, which was different from non-health care workers and the total cases (Figs. 3 and 4).

TABLE 4

Distribution of Contact History

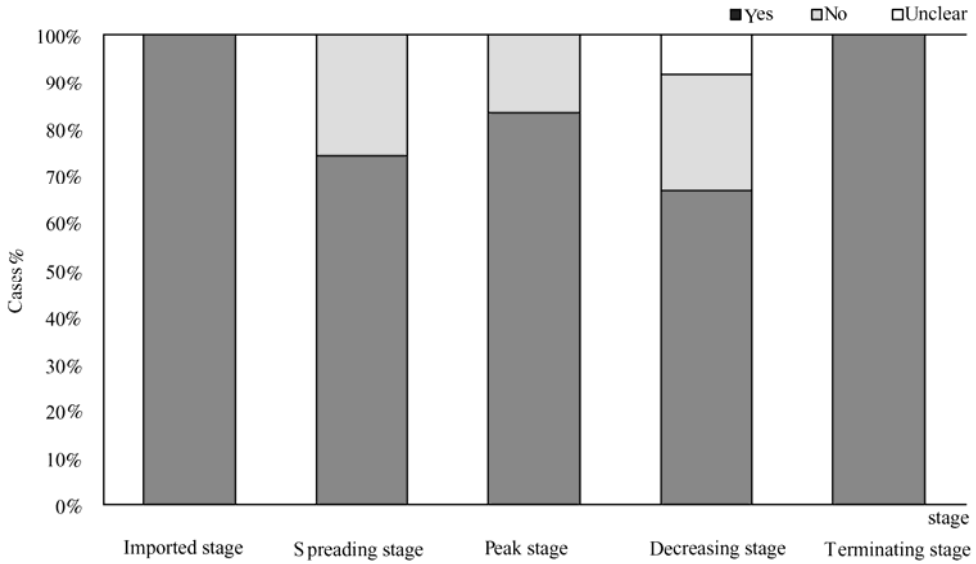| Contact History	Health Care Workers		Non-health Care Workers		Total	
	No.	%	No.	%	No.	%
Yes	328	85.86	1 074	56.44	1 402	61.36
No	54	14.14	829	43.56	883	38.64
Total	382	100.00	1 903	100.00	2 285	100.00

Note. [*]χ^2=116.188, *P*=0.000.

FIG. 3. Contact history of health care workers in different stage.
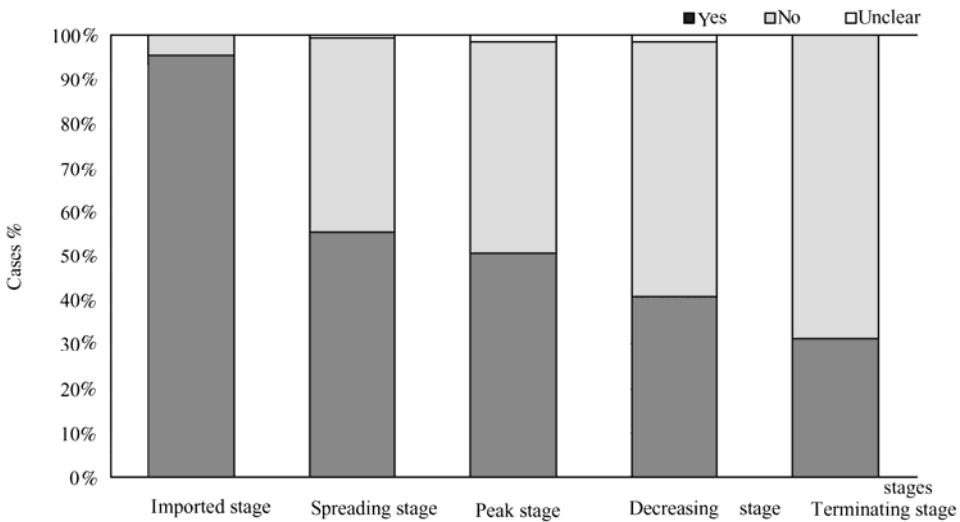

FIG. 4. Contact history of non-health care workers in different stages of SARS.

DISCUSSION

To comprehend the transmission routes, in particular, the contact history of a communicable disease is of great significance for preventing and controlling of its dissemination[7]. Although we have no clear picture of the epidemiological features of SARS, infectious droplets in a short distance have been confirmed as a major route of transmission. But also, there still existed the possibilities that the virus could be transmitted through contact with respiratory tract secretions discharged from mouth, nose and eyes of infected persons. So far, experts still have no evidence to deny the possible transmission through feces-oral route.

The virus of SARS becomes easier to be infected in a bad ventilation situation. Most SARS cases were identified in municipal cities, prefectures, and aggregated infections were observed in some families as well as in hospitals[8]. Due to lack of effective drugs and vaccines, the major measures to hold back the spread of SARS are early diagnosis, earlier isolation of probable and suspected cases as well as sterilization of their stuffs. Therefore, understanding the contact history is of great importance for SARS prevention and control.

Distribution by contact history of probable cases Table 1 shows that about 59.81% of probable cases contacted SARS patients before their infections, which was significantly higher than the excluded cases (34.58%). Contact history may be deduced as a sufficient pre-condition for SARS infection. In another word, not all processes of contact history are necessarily infected.

Time distribution of clinical probable cases, For the SARS probable cases, there existed a coincident epidemic tendency in the distributions by onset time and close contact history. An increasing gradient of contact history at the primary stage of SARS pandemic was observed, with the number of reported SARS cases increased. The proportion appeared to decrease gradually till no contact history was identified at the final stage of epidemic. This indicated that the spread of SARS in the communities of Beijing was gradually eliminated.

On the other hand, it implied that some weakness might potentially exist in the processes of our preventive work. As we all acknowledge, history of contact is an indispensable precondition for transmission of a communicable disease. In the data analyzing, we realized that such understanding was not consistent with the common knowledge about an infectious disease as the proportion of the contact history was gradually reduced. As a matter of fact, this decreased gradient did not exist among HCWs. A

study[9] showed that 30%-50% of the patients without SARS contact history consulted doctors within two weeks. This indicated that the infection of partial cases not only might be relevant to iatrogenic infection, but also might be a result of unconsciousness or ignorance of SARS contact history.

Therefore, some presumptions upon the decreased gradient of proportion of the contact history of the whole studied population could be made as followings. ①Information bias existed in this survey, which implied that some study subjects failed to remind or remember that they contacted SARS patients. Meanwhile, some follow-up failures might be and impeded the validities. ② Psychological problems of some patients made it impossible for them to release their history of SARS contact. ③ Many patients did not consult doctors during the SARS epidemic, which made potential infection possible in the society. For instance, taxi drivers refused a passenger's lifting requirement. Therefore, the passenger who might be infected with SARS virus had to take bus for instead, which made spread of SARS possible. Some further studies are needed for a deep investigation of the above matters.

Risk analysis of outcome and contact history of SARS cases The fatality rate of cases with clear SARS contact history was significantly higher than that of those with no history of contact (OR: 1.49). This indicates that the history of SARS contact might be one of the risk factors. As the death of SARS patients was closely associated with the severity of the disease, medical proficiency, timely clinical consulting, and the health status of patients prior to SARS infection, therefore, the history of SARS contact could not be regarded as the sole risk factor and multi-factor analysis was required for further exploration.

Analysis of contact history of HCWs The proportion of contact history among HCWs was significantly higher than that among non-health care workers, which was coincident with transmission features of SARS (OR:4.69). The risk of SARS virus affecting HCWs was as 5 times as that of NHCWs. Health workers were the main forces fighting against SARS, and they were at high-risk to be affected by SARS. It is necessary to enhance the protective measures for HCWs, and maximally reduce the SARS prevalence among them. Since effective measures were taken by Beijing municipal government, such as pre-service training for health workers, strengthening management of sterilization and isolation, assigning special health-security supervisors[10], no new SARS cases were identified among HCWs at the finial period of epidemic.

Statistics showed that 14.14% of HCWs had no history of SARS contact. The possible reasons might be as follows. ①There was recall bias. ②HCWs were defined as clinical doctors, nurses and other staff members working in the hospital, therefore, some of the HCWs had no chance to contact SARS patients directly, and even no idea of the second definition about the history of contact. ③As more and more information was disseminated, the health authorities strengthened protection of HCWs, and HCWs themselves took self-protective measures.

CONCLUSION

Based on the analysis of SARS contact history prior to infection, some conclusions might be drawn as follows: ①A clear SARS contact history might be a sufficient precondition. ②The protective awareness of people has increased gradually. ③The SARS contact history might be one of the risk factors. ④ The risk of HCWs affected with SARS virus to HCWs is as 5 times as that of NHCWs.

STUDY WEAKNESS

The variables used in the present survey are far from being sufficient, and some missing data and inadequate quality control in the survey have impeded our effort to further explore SARS related problems. As case-control study became impossible due to limited research conditions, some definite conclusions could not have been drawn. A specially designed survey focusing on this topic should be carried out to further investigate epidemic features of SARS, which would benefit prevention and control of this disease in the future.

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