

Analysis of Risk Factors for Norovirus Gastroenteritis Infection from Hospital Patients to Nursing Staff in a Patient's Ward

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(Accepted July 22, 2010)

In November 2006 there was a mass outbreak of norovirus gastroenteritis mainly in the neurosurgery ward of Tokyo Women's Medical University Medical Center East. Originating from inpatients, a total of 38 people, including nursing staff, developed the disease. The attack rate of the disease was highest among nursing staff at 58%. Therefore, we analyzed the risk factors for the occurrence of norovirus gastroenteritis in the nursing staff. In a case control study, the nursing staff was surveyed by questionnaire on items that may have been risk factors for contracting the disease. The questionnaire included sex, age, length of nursing experience, blood type, hand-washing and the use of personal protective equipment (PPE), contact with the specific patients, dietary/snack habits, use of toilets in the ward, and history of infectious gastroenteritis. The subjects for the analysis were 26 nurses working in the neurosurgery ward. They consisted of 15 staff who developed the disease and 11 staff who remained unaffected. Using the latter as the control group, an analysis was conducted. Of the questionnaire items presented above, the odds ratio for the risk factor of age under 30 was as high as 11.4 (95% confidence interval: 1.7-78.4; $p = 0.024$), demonstrating a statistically significant relationship. No significant relationship was observed with other factors. In conclusion, the risk of contracting norovirus gastroenteritis was suggested to be high among younger nursing staff members than 30 years of age.

Key words: Norovirus infection, infectious gastroenteritis, outbreak, risk factor, nursing staff

Background and Purpose

In November 2006, when infectious gastroenteritis was prevalent throughout Japan, a mass outbreak of norovirus gastroenteritis occurred mainly in the neurosurgery ward of Tokyo Women's Medical University Medical Center East. Originating from inpatients, the infection was transmitted to those who were inside the ward such as nursing staff, a nursing student, and visitors. The attack rate was highest among the nursing staff at 58%. Nursing staff generally have closer and more frequent contact with patients than physicians and other healthcare workers. Their profession itself, therefore, may have been a risk factor for infection and onset of the disease. However, considering that

it would be significant for infection control to investigate what risk factors were actually involved in this mass outbreak of norovirus gastroenteritis, an analysis of risk factors was conducted.

Subjects and Methods

A case control study was performed in the nursing staff working in the neurosurgery ward where the mass outbreak of norovirus gastroenteritis occurred. After termination of the mass outbreak, the subjects were surveyed by a questionnaire consisting of items that may have been risk factors for infection and onset of the disease. The questionnaire items included sex, age, length of job experience, blood type (to evaluate the association between the blood type and the susceptibility to norovirus infec-

Table 1 Questionnaire

This survey will serve in an epidemiological analysis which aims to estimate the infection risk of this infectious gastroenteritis outbreak. This information will be handled with great care, so please try to answer honestly.

Please answer the following questions by circling the appropriate answer.

Development of gastroenteritis: Yes-No

Gender: Male-Female

Age: ___ years

Years of employment as a nurse: ___ years

Blood type (ABO):

1. Do you usually wear gloves when handling patients' feces? (Yes-No)
2. Do you usually wash your hands before and after wearing gloves? (Yes-No)
3. Do you usually clean your hands with a quick-drying hand antiseptic instead of running water? (Yes-No)
4. Did you wear gloves improperly between 11/1 and 11/25? (Yes-No)
5. Did you wash your hands improperly between 11/1 and 11/25? (Yes-No)
6. Do you usually wear an apron when handling patients' feces? (Yes-No)
7. Did you wear an apron improperly between 11/1 and 11/25? (Yes-No)
8. Do you usually wear a mask when in contact with patients? (Yes-No)
9. Did you wear a mask improperly between 11/1 and 11/25? (Yes-No)
10. Were you in direct contact with patient A between 11/1 and 11/25? (Yes-No)
11. Were you in direct contact with patient B between 11/1 and 11/25? (Yes-No)
12. How many times did you work the late-night shift between 11/1 and 11/25? (___times)
13. Did you work mainly in the brain surgery unit between 11/1 and 11/25? (Yes-No)
14. Did you work mainly in the surgical unit between 11/1 and 11/25? (Yes-No)
15. Did you work mainly in a leadership position (such as giving instructions) between 11/1 and 11/25? (Yes-No)
16. Do you often eat sandwiches or onigiri (rice balls) at meals while at work? (Yes-No)
17. Do you ever eat snacks during rest time while at work? (Yes-No)
18. Do you bite your nails? (Yes-No)
19. Do you have peeling or chapped skin on your hands? (regardless of degree) (Yes-No)
20. Do you feel a stinging pain on your hands when water or antiseptic is applied? (Yes-No)
21. Do you use the staff toilet while at work? (Yes-No)
22. Have you ever suffered from infectious gastroenteritis during winter? (Yes-No)

<Thank you for your cooperation. Infection Prevention Office>

tion), hand-washing and use of personal protective equipment (PPE), contact with specific patients, dietary/snack habits (e.g., whether they often ate foods intended to be eaten with the hand such as rice balls and sandwiches; whether they tended to eat snacks during rest breaks), use of toilets in the ward, history of infectious gastroenteritis, and whether they had extremely rough hands. Regarding appropriateness of hand-washing and use of PPE, the subjects were asked to answer separately about their daily habits and their special compliance during the period of prevalence of norovirus gastroenteritis. Two patients who developed the disease were selected for the survey item that addressed contact with specific patients. One of these 2 patients was a 64-year-old female (identified as Patient A) who required assistance with eating and toileting and some of whose family members and visitors also developed the disease. The other patient was a 2-year-old female (identified as Patient B), who was held in the arms of staff members most of the time.

The questionnaire used in this study is shown in Table 1.

Epi Info (ver. 3.3) was used for the statistical analysis. P values < 0.05 were considered statistically significant.

Results

A summary of the mass outbreak of norovirus gastroenteritis is shown in Table 2. All the noroviruses detected were GII. Fig. 1 shows the epidemic curve for the cases. The outbreak started with 4 inpatients; 2 of them were fed by tube and the other 2 patients received a normal hospital diet. The former shared the same room and the latter stayed separately in 2 different rooms. It is not known if any interrelation among these patients who had an influence on the onset of the disease. The families and visitors of these patients, a nursing student present as an on-the-job trainee and her teacher, and nursing staff were infected within a short period, creating a propagated epidemic curve. No doctors were affected by the disease.

Table 2 Summary of subjects

Total number of patients	38
Inpatients	15 (Neurosurgery: 11, Surgery: 4)
Patients' families	6
Nursing staff	15 (Nurses: 14, Assistant nurse: 1)
Nursing school members	2 (Student: 1, Teacher: 1)
Age	2-74 y
Sex	8 males, 30 females
Symptoms and outcomes	
Diarrhea, vomiting	
All patients resolved	No patients seriously affected
Examination	Noroviruses were detected in 5 of 8 fecal samples collected from 7 patients

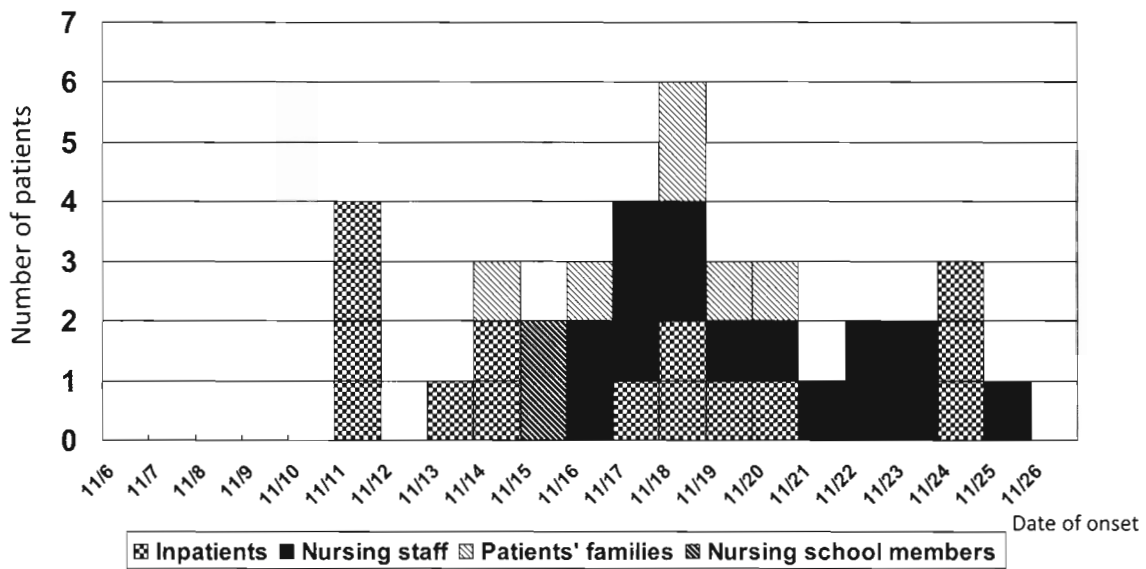


Fig. 1 Epidemic curve (n = 38)

The ward in question served multiple departments with focus on neurosurgery. Nursing staff are responsible for each patients room, but on night shift fewer staff work beyond the boundary of rooms. Twenty-six members of the nursing staff working in this ward (25 nurses and 1 assistant nurse) were the subjects of this investigation. Fifteen of these 26 subjects were affected by the disease, making their attack rate 58%. An analysis was conducted using 11 nurses who worked in the same ward without developing the disease as the control group.

All the subjects except for one were females. As shown in Fig. 2, their ages were between 22 and 48 years (mean 29.2, SD 7.4, median 27 years). Since the affected group of 15 and the control group of 11 were distributed around the age of 30 years, age un-

der 30 was used as one of the risk factors in the analysis.

The analysis results are shown in Table 3. The odds ratio for the risk factor of age under 30 was as high as 11.4 (95% confidence interval: 1.7-78.4; p-value = 0.024), indicating a statistically significant relationship. Though the odds ratio for the risk factor of job experience under 10 years was as high as 8.0 (95% confidence interval: 0.7-85.7; p = 0.163), it was not statistically significant. No statistically significant relationships were detected regarding other risk factors such as blood type, hand-washing and use of PPE during the period of prevalence of the disease, contact with patient A, snack habits, history of infectious gastroenteritis, or whether they had extremely rough hands. In response to the questions on daily hand-washing habits and use of

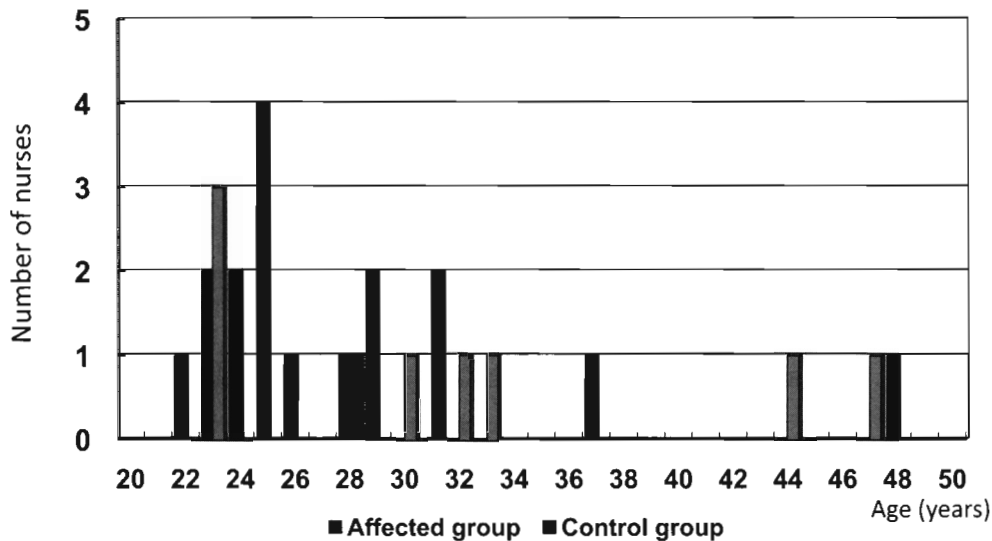


Fig. 2 Ages of the nursing staff surveyed (n = 26)

The affected group of 15 and the control group of 11 were distributed around the age of 30 years.

Table 3 Analysis results on risk factors

Risk factors	Affected group		Control group		Infection (Odds ratio)	95% confidence interval	p
	+	-	+	-			
Age < 30	13	2	4	7	11.4	1.65-78.38	0.024
Experience < 10years	14	1	7	4	8.0	0.74-85.72	0.163
O blood type	2	13	3	8	0.4	0.05- 3.01	0.698
Improper use of gloves	4	11	0	11	undefined	undefined	—
Improper hand-washing	7	8	3	8	2.3	0.43-12.39	0.550
Improper use of mask	5	10	4	7	0.9	0.17- 4.47	0.797
Improper use of apron	5	10	2	9	2.3	0.34-14.61	0.679
Contact with A	13	2	10	1	0.7	0.05- 8.22	0.774
Snack habits	14	1	8	3	5.2	0.46-59.29	0.374
History of gastroenteritis	1	14	0	11	undefined	undefined	—
Rough hands	7	8	3	8	2.3	0.44-12.39	0.551

PPE, contact with patient B, and use of toilets in the ward, all 26 subjects provided the same answer, "Yes." Therefore, these risk factors were excluded from the analysis.

Discussion

Mass outbreaks of norovirus gastroenteritis in hospitals, facilities for the elderly, child-care facilities, schools, dining facilities, and accommodation facilities have become an issue of public concern. There are two main factors identified as causes of such mass outbreaks; food poisoning attributable to contaminated food provided in the facilities and the human-to-human infection spread through feces or vomitus. Noroviruses are relatively stable in the environment and are easily transmitted. They are

highly contagious and only a small number of virus particles are sufficient to cause infection. Therefore, utmost care must be taken to prevent infection.

In the fall and winter in 2006, infectious gastroenteritis became prevalent throughout Japan and the number of patients in 2006 was higher than in any other year since 1981 when surveys of infection outbreaks started²¹. The remarkable number of patients in 2006 has not been exceeded in the following three years. The cause of this epidemic has not been clarified. A mass outbreak occurred in the facility where the author worked when institutional outbreaks had been frequently reported in the mass media. The Infection Control Committee took the lead in resolving the case under the guidance

and cooperation of a local healthcare center.

The epidemic curve of this outbreak indicated a propagated epidemics starting with simultaneous onset of the disease in 4 patients. These patients had nothing in common such as diet. Though some other persons might have developed the disease earlier than they did, no such persons were found in our investigation. After the resolution of this mass infection case, a patient in another ward developed the disease. With the continual support of the healthcare center, this new case was resolved without infecting any other people. Fifteen of the 38 affected patients were nursing staff. They accounted for 58% of all nursing staff (26) working in the relevant ward. Because of the high prevalence and incidence among nurses as well as the high level of cooperation that could be obtained, nursing staff members were chosen as the subjects of this investigation of risk factors for norovirus gastroenteritis.

It has been reported that genetic factors are involved in sensitivity to noroviruses²⁾ and that individuals with O blood type have high sensitivity to noroviruses³⁾. However, no significant difference was observed regarding blood types in this survey.

Noroviruses are transmitted primarily through contact but can also spread via a droplet route or, under specific circumstances, via an airborne route⁴⁾⁵⁾. This case of mass outbreak occurred in the ward used mainly by the department of neurosurgery which housed many patients who were critically ill or with poor ADL (Activities of Daily Living). It is to be expected that nurses, who often have contact with patients and handle the feces or vomitus of patients, have a high risk of infection. However, some nurses working in the ward remained unaffected during the spread of the infection. Therefore, it was considered worthwhile to analyze this case in an effort to clarify the factors which generated this difference among the nursing staff.

As a result of the analysis, age under 30 years was identified as a potential risk factor for occurrence of the infection, with a statistically significant relationship. Considering that the age factor could be related to the length of nursing experience, an analysis was also conducted regarding length of ex-

perience. However, no significant difference was detected. Similarly, there was no significant difference regarding infection control techniques such as hand-washing and use of PPE. However, because this investigation was conducted using self-reported data provided after termination of the mass outbreak, it remains unclear to what degree infection control measures had actually been taken before and during the case. Furthermore, age-related differences in tasks in nursing practice may also have been a confounding factor. It is possible that older nurses were in charge of instructing or managing younger nurses and that, therefore, they had less direct contact with patients. In this study, a difference in tasks among the nurses during the spread of the infection was not investigated. It is generally said that noroviruses can often re-infect previously infected hosts, regardless of the age of such hosts, unlike rotaviruses which often produce immunity to reinfection⁶⁾. In fact, mass outbreaks of norovirus gastroenteritis have been observed in facilities for the elderly. However, there is a report that antibody prevalence rate increases with increasing age⁷⁾. In this study, age under 30 years was the only risk factor for norovirus gastroenteritis in which a statistically significant difference was observed. It can be speculated that nursing staff aged 30 and over have antibody against noroviruses. However, this result may have been affected by the fact that the subjects for analysis were limited to a specific population, healthcare workers. Further investigation is needed to confirm the reliability of this result.

Conclusion

Risk factors for the occurrence of norovirus gastroenteritis in the nursing staff were investigated in this study. As a result, it was suggested that risk of infection was higher among those who were under 30 years of age. No significant relationship was observed with the length of nursing experience. Outbreaks of this disease in facilities for the elderly have been an issue of concern. It is reported that infection with noroviruses can occur repeatedly in the course of a lifetime. In this study, however, it was demonstrated that risk of infection was higher

among those who were under 30 years of age.

Acknowledgement

I would like to express my gratitude to the nursing staff in the East 4B Ward in Tokyo Women's Medical University Medical Center East for their participation in the survey, to Dr. Takaaki Ohyama of the Infectious Disease Surveillance Center, National Institute of Infectious Diseases for his helpful advice, and to Prof. Shigetaka Sugihara, Department of Pediatrics in Tokyo Women's Medical University Medical Center East for unwavering support.

The summary of this study was presented in the 23rd Academic Conference of the Japanese Society of Environmental Infections.

References

- 1) Ministry of Health, Labour and Welfare/National Institute of Infectious Diseases. Infectious Diseases Weekly Report Japan 8 (48): 5-6, 2006
- 2) Parrino TA, Schreiber DS, Trier JS et al: Clinical immunity in acute gastroenteritis caused by Norwalk agent. N Engl J Med 297: 86-89, 1977
- 3) Hutson AM, Atmar RL, Graham DY et al: Norwalk virus infection and disease is associated with ABO histo-blood group type. J Infect Dis 185: 1335-1337, 2002
- 4) Sawyer LA, Murphy JJ, Kaplan JE et al: 25- to 30-nm virus particle associated with a hospital outbreak of acute gastroenteritis with evidence for airborne transmission. Am J Epidemiol 127: 1261-1271, 1988
- 5) Gallert GA, Waterman SH, Ewert D et al: An outbreak of acute gastroenteritis caused by a small round structured virus in a geriatric convalescent facility. Infect Control Hosp Epidemiol 11: 459-464, 1990
- 6) O'Ryan ML, Lucero Y, Prado V et al: Symptomatic and asymptomatic rotavirus and norovirus infections during infancy in a Chilean birth cohort. Pediatr Infect Dis J 28: 879-884, 2009
- 7) Kobayashi S, Fujiwara N, Takeda N et al: Seroprevalence study of norovirus infection in Aichi Prefecture, Japan. Microbiol Immunol 53: 356-359, 2009

看護職員におけるノロウイルス胃腸炎発症の危険因子について

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2006年11月、東京女子医科大学東医療センター脳神経外科病棟を中心としてノロウイルス胃腸炎の集団発生がみられた。入院患者を発端とし、看護職員など当該病棟関係者計38名が発症した。看護職員の罹患率が58%と最も高かったため、看護職員におけるノロウイルス胃腸炎発症の危険因子について解析を行った。方法は症例対照研究で、質問票にて感染および発症の危険因子になり得ると考えられる項目について有無を尋ねた。性、年齢、経験年数、血液型、手洗いや個人防護具(PPE)使用、特定の患者との接触、食事や間食の習慣、病棟内トイレの使用、感染性胃腸炎の既往などについて検討した。解析にはEpi Info (ver.3.3)を用いた。看護職員26名が対象となったが、発症者は15名であり、同じ病棟に勤務しながら発症しなかった残りの11名を対照として解析を行った。上記項目のうち、年齢30歳未満の発症リスクのみがオッズ比11.4(95%信頼区間1.7-78.4, p=0.024)と高く、統計学的にも有意な関連が推定された。経験年数やその他の因子との関連はなかった。

看護職員においては、年齢30歳未満でノロウイルス胃腸炎発症の危険が高いことが示唆された。