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Infection of exposed patients during norovirus outbreaks: are there predictive parameters?

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SUMMARY

Background: Norovirus outbreak management comprises isolation and cohorting of patients. In this context, exposed patients are preferably cohorted separately from symptomatic and unexposed asymptomatic patients, since they potentially develop symptoms of norovirus gastroenteritis. Whether routinely examined clinical or laboratory parameters can help to predict occurrence of gastroenteritis symptoms in those patients has not yet been examined.

Aim: To evaluate routinely examined clinical and laboratory parameters as predictive values for the development of norovirus symptoms in exposed patients during outbreaks.

Methods: Exposed patients during norovirus outbreaks were observed throughout a two-year period in the university hospital of Muenster. The development of laboratory-confirmed norovirus gastroenteritis symptoms was examined in exposed patients, and clinical as well as laboratory parameters prior to onset of the outbreak were compared in exposed symptomatic and asymptomatic patients.

Findings: We detected 42 exposed patients within 10 outbreaks. Of these, 33 remained asymptomatic, whereas nine patients developed norovirus gastroenteritis. Exposed symptomatic patients were significantly older (50 ± 10.51 vs 28 ± 4.68 years), had significantly higher blood sodium concentration (142.5 ± 1.48 vs 138.8 ± 0.47 mmol/L) and higher systolic blood pressure (119.3 ± 3.84 vs 108.5 ± 2.41 mmHg). Development of symptoms among exposed patients was significantly associated with blood type O (75% vs 20%).

Conclusion: In order to minimize patient-to-patient transmission within norovirus outbreaks in hospital, risk stratification of exposed patients is helpful. To achieve this, routinely detected clinical and laboratory parameters can be useful to predict development of symptoms in these patients.

Introduction

Norovirus infections globally cause symptoms of acute gastroenteritis in humans.[1] Affected persons develop typical symptoms of diarrhoea, vomiting and nausea after an average incubation time of 10–51 h.[2] Median duration of illness lasts another two days in otherwise healthy persons.[3] Norovirus

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particles are easily transmitted faecal–orally or via droplets from one person to another.[2] Studies investigating secondary attack rates during hospital outbreaks highlight patient-to-patient transmission as the predominant mode of transmission.[4] In addition, the sustained viability of norovirus particles in healthcare environments and the very low infection dose of fewer than 100 particles increase the risk of infection.[5,6] Hence norovirus outbreaks occur within healthcare facilities, e.g. hospital wards.[7,8] By contrast, recently published data demonstrated that individual cases of norovirus infections in hospitals do not unavoidably lead to outbreak scenarios.[9]

Besides intensified cleaning and disinfection, food and water safety, staff division and closure of affected wards, outbreak management within hospital settings includes isolation and cohorting of patients.[7,10] In these cases, separation of patients into three cohorts due to their exposure and infection status is desirable: symptomatic, exposed asymptomatic and unexposed asymptomatic patients. In cases where there are insufficient personnel or where infrastructural limitations preclude this strategy, a two-cohort system comes into play; here patients are separated either into exposed versus unexposed or symptomatic versus asymptomatic cohorts.[11] Both strategies require a decision on how to deal with patients being potentially exposed to norovirus particles. To what degree patients are susceptible to norovirus particles is dependent on various aspects including virus-associated factors, infection control interventions, and host factors.[12–14] Whereas detecting virus-specific evidence is very challenging, especially in newly/recently discovered outbreaks, some patients' clinical and laboratory parameters can easily be gathered.

In this study we sought to determine whether these parameters, tested previously during routine examination, can be used to predict development of symptoms of norovirus gastroenteritis in patients exposed by patient-to-patient contact.

Methods

Study design

We identified patients being exposed to norovirus-infected (laboratory-confirmed) index patients (hereafter called 'infectious patients') presenting productive symptoms (diarrhoea, vomiting) during norovirus outbreaks in the 1500-bed university hospital of Muenster between November 2014 to November 2016.

Microbiological testing

Stool samples of symptomatic patients were tested for norovirus applying RIDA®GENE Norovirus I & II real-time reverse transcriptase–polymerase chain reaction (RT–PCR) (r-biopharm, Murten, Switzerland) after RNA extraction via QIAamp MinElute Virus Spin Kit® (Qiagen, Hilden, Germany). Vomitus of symptomatic patients was not tested, because the test was not validated for this sample type. Asymptomatic patients were not tested for norovirus excretion, following current national recommendations.[15]

Outbreak management on wards

Outbreaks were defined as occurrence of two or more similar infections resulting from a common exposure that is either suspected or laboratory-confirmed to be caused by norovirus. After identification, norovirus outbreaks were reported to the public health department. Infection control management was performed as described in detail elsewhere.[7,16] In brief, patients were isolated or cohorted, if possible, into three groups: symptomatic patients, and exposed and unexposed asymptomatic patients. Toilets and bathrooms were separated and staff was divided into groups, each caring for one of the patient cohorts. De-isolation of patients was performed 72 h after resolution of symptoms. Sick staff members were excluded from work according to the same criteria. Rooms in which symptomatic patients were isolated or cohorted were entered with personal protective equipment [gloves, FFP2 (filtering face piece, level 2) masks, gowns and if necessary face shields]. Disinfection of hands was performed using disinfection agents containing 95% ethanol (Sterilium virugard®, BODE Chemie GmbH, Hamburg, Germany). Surface cleaning and disinfection (Perform®, Schülke & Mayr GmbH, Norderstedt, Germany) was intensified until at least 14 days after the end of the outbreak.

Exposed patients

Exposed patients were defined as patients having direct contact with symptomatic, laboratory-confirmed norovirus patients. Exposed patients were identified using timelines, compiled during outbreaks routinely, and the ORBIS® (Agfa, Morstel, Belgium) hospital information system to specify exact

Table I
Norovirus outbreaks between November 2014 and November 2016

Outbreak no. (year)	Ward no.	Symptomatic patients	Exposed patients		Symptomatic staff
			Symptomatic	Asymptomatic	
1 (2014)	1	5	0	2	2
2 (2014)	2	4	0	1	6
3 (2015)	3	5	1	2	5
4 (2015)	4	12	2	3	3
5 (2015)	5	8	0	9	1
6 (2015)	2	4	0	1	1
7 (2015)	6	19	5	3	11
8 (2016)	7	4	0	6	0
9 (2016)	5	3	0	4	4
10 (2016)	5	11	1	2	6
Total		75	9	33	39